



# DLR Group

Architecture  
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## **REBID DUTCHESS STADIUM NEW LEFT FIELD CLUBHOUSE, SEATING BOWL, & RESTROOM BUILDING FISHKILL, NEW YORK**

Bid Set County Project #RFB-DCB-18-22

**Project Manual – Volume 4 of 4  
Civil Specifications – NY DOT Standards**

NOVEMBER 04, 2022

### **Bid Set**

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FISHKILL, NEW YORK

57-21113-00

BID SET  
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# SPECIFICATIONS CIVIL DISCIPLINE

SPECIAL SPECIFICATIONS

NYS DOT STANDARD SPECIFICATIONS

APPLIES TO ALL CIVIL DISCIPLINE ("C" SERIES) PLAN SHEETS

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## SPECIAL SPECIFICATIONS

**ITEM 208.01030022                      BIORETENTION AND DRY SWALE SOIL**  
**ITEM 208.01040022                      LABORATORY TESTING FOR SOIL PHOSPHORUS**  
**CONCENTRATION**

**DESCRIPTION**

This work shall consist of installing Bioretention and Dry Swale Soil in accordance with the contract documents and as directed by the Engineer.

The work shall also consist of having the Bioretention and Dry Swale Soil tested for total soil phosphorus concentration at a qualified laboratory. A qualified laboratory shall be defined as a laboratory that is certified by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) to test soil for total soil phosphorus.

**MATERIALS**

The following sections of the standard specifications apply:

§703-07                                      Concrete Sand  
§713-01                                      Topsoil, Type A (see exceptions below)

The soil for Bioretention areas and Dry Swales shall be a uniform mix, free of stones, stumps, roots or other objects larger than two inches (2”) in diameter. The Bioretention and Dry Swale soil shall be visibly free of noxious weeds.

Bioretention and Dry Swale Soil shall be a well blended mixture of three (3) parts sand and one (1) part topsoil, by volume. The Bioretention and Dry Swale Soil shall have a pH range of 5.2 to 7.6, and an organic content of 3-7%.

Sand shall meet the requirements of §703-07 *Concrete Sand*.

Topsoil shall be in accordance with the requirements of §713-01 *Topsoil* for Topsoil Type A, except as follows:

- All topsoil shall be sampled and tested, regardless of the source.
- Sampling of topsoil, amended topsoil, and the Bioretention and Dry Swale Soil shall be done by the Contractor/Supplier. Sampling protocol shall be in accordance with §713-01 *Topsoil*.

Soil amendments to increase organic content shall be peat moss. Peat moss shall be commercially produced and shall be composed of the partly decomposed stems and leaves of any or several species of sphagnum moss. It shall be free from wood, decomposed colloidal residue, and other foreign matter. It shall have a pH range between 3.5 pH - 5.5 pH as determined in accordance with the Association of Official Agricultural Chemists’ testing methods. It’s water-absorbing ability shall be a minimum of 1100% by weight on an oven-dry basis.

Acceptance of Bioretention and Dry Swale soil will be based upon a material certification that the



**ITEM 208.01030022**                    **BIORETENTION AND DRY SWALE SOIL**  
**ITEM 208.01040022**                    **LABORATORY TESTING FOR SOIL PHOSPHORUS**  
**CONCENTRATION**

material conforms to the above requirements. The Contractor/Supplier shall provide to the Engineer copies of testing results of the sand gradation, topsoil gradation, organic content percentage of the Bioretention and Dry Swale Soil, and pH of the Bioretention and Dry Swale Soil. These tests are to be paid under the Bioretention and Dry Swale Soil item.

The Contractor shall provide to the Engineer copies of testing results for Soil Phosphorus Concentration. Samples to be submitted to the qualified laboratory shall be obtained in accordance with §713-01 *Topsoil*. Sampling shall be paid under the pay item for Bioretention and Dry Swale Soil. The results of the Soil Phosphorus analysis shall not be used as the basis for material acceptance.

Sampling frequency for total phosphorous shall be one composite sample for the first 100 to 500 cubic yards of soil, and an additional composite sample for each additional 500 cubic yards, or portion thereof. No samples are required for stockpiles of less than 100 cubic yards.

**CONSTRUCTION DETAILS**

Bioretention and Dry Swale Soil shall be installed at the locations and to the depth(s) as shown in the contract documents. Placement of Bioretention and Dry Swale Soil shall be done in lifts of 12 inches to 18 inches. The soil shall be loosely compacted, such as by tamping lightly with a dozer or backhoe bucket. No other materials or substances shall be mixed or dumped within the Bioretention area and Dry Swale that may be harmful to plant growth, or prove a hindrance to planting or maintenance operations.

**METHOD OF MEASUREMENT**

**Bioretention and Dry Swale Soil**

The work will be measured as the number of cubic yards of Bioretention and Dry Swale Soil installed, computed from payment lines shown in the contract documents.

**Laboratory Testing for Soil Phosphorus Concentration**

The work will be measured by the number of soil samples analyzed for Soil Phosphorus Concentration by a qualified laboratory.

**BASIS OF PAYMENT**

The unit price bid for a cubic yard of Bioretention and Dry Swale Soil shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including costs for testing.

The unit price bid for Laboratory Testing for Soil Phosphorus Concentration, shall include the receipted costs of testing, including the cost of the laboratory test(s) and all labor, materials and equipment required to obtain and deliver soil sample(s) to the qualified laboratory plus 5% for profit

**ITEM 208.01030022      BIORETENTION AND DRY SWALE SOIL**  
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and overhead.

**ITEM 304.11000008 - SUBBASE COURSE (MODIFIED)**

**DESCRIPTION:**

All the provisions of Section 304 pertaining to Subbase Course, Type 1 shall apply. The contractor may at their option substitute Subbase Course, Type 2. If Subbase Course, Type 2 is substituted all the provisions of Section 304 pertaining to Subbase Course, Type 2 shall apply.

## **ITEM 603.98XX0007- POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

### **DESCRIPTION:**

Under this item the Contractor shall furnish, install and test (PVC) Sewer Pipe and fittings of the size and at the locations shown on the plans or as ordered by the Engineer.

### **MATERIALS:**

The Contractor shall be responsible for all material furnished under this item and shall replace at his expense all material found defective in manufacture or damaged in handling. Materials shall be as follows:

#### **POLYVINYL CHLORIDE (PVC) SEWER PIPE**

All Polyvinyl Chloride (PVC) pipe and fittings shall meet or exceed all of the requirements of ASTM specification D3034, "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings," 4 NPS through 15 NPS, Class SDR-35 and ASTM F679 "(Polyvinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings" for 18 NPS through 36 NPS. The minimum modulus of elasticity shall be 19 lbs/sq. ft. All pipes shall be suitable for use as a gravity sewer conduit. Provisions must be made for contraction and expansion at each joint with a rubber ring. The bell shall consist of an integral wall section which securely locks the solid cross-section rubber ring into position. The gasket shall meet the requirements of ASTM F477-76.

Fittings - All fittings and accessories shall be as manufactured and furnished by the pipe supplier, and have bell and/or spigot configurations identical to that of the pipe to which they are connected. Service connections shall be of the "tee-wye" combination. The PVC pipe shall be cut to the correct length in the field as necessary to allow installation of new service connections or service connections to existing laterals.

Saddles - Where it is impractical to install a PVC "tee-wye" service connection, a saddle may be used to make a service connection for new lateral.

The saddle shall contain a rubber (O) - ring gasket cemented in place in accordance with ASTM D1869 specifications. The saddle shall have a spigot or bell inlet suitable for acceptance of the kind and size of lateral pipe to be connected. If necessary, a flexible coupling or gasket may be used to connect the lateral to this saddle. The saddle shall be installed in accordance with the manufacturer's specifications and shall meet any requirements established by the owners of the sewer system.

## **ITEM 603.98XX0007- POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

### **CONSTRUCTION DETAILS:**

- A) **EXCAVATION** - Excavation shall conform to the requirements of Item 206.02 - Trench and Culvert Excavation or Item 206.04 - Trench and Culvert Excavation - O.G., except as modified herein and the limits are shown in the Contract Plans.
- B) **BACKFILLING** - No trench, pit or other excavation shall be backfilled until the pipe or appurtenant structures contained therein shall have been completely installed and inspected and approved by the Engineer. In backfilling around and over pipes, stone bedding material shall be spread in layers not over 6 inches in depth on both sides of the pipe and thoroughly spaded and tamped around the pipe so that no displacement of the pipe results. Backfill for a minimum distance of 2 ft above the top of the pipe shall be of the same material and shall be spread in layers not to exceed 6 inches in thickness or depth and each layer shall be thoroughly compacted by spading and tamping before further refilling is done. In all cases, the backfill above the top of the pipe shall be placed to a minimum of 18 inches before compaction is begun directly over the pipe.
- C) **DISPOSAL OF WATER** - Except when included in another specification (i.e. work area located in a hazardous or contaminated area), water in excavated trenches or pits shall be removed by pumping, bailing or other satisfactory method before the installation of any pipe or structure. Water so removed shall be conveyed to such places and points that it will not interfere with the progress of the work or be a hazard or damage to public or private property. No water containing mud, grit or substances that would settle and be detrimental to the operation of sanitary sewers shall be permitted to flow into any storm or sanitary sewer or drain. No sewage entering excavated trenches or pits shall be pumped or dumped into any surface drainage course. No water, sewage or other material shall be allowed to enter any water main.
- D) **LAYING SEWER PIPE** - Excavation of trenches for sewer pipe shall be made to the line and grade established or as directed by the Engineer and shall be made straight and true with no deviations from a straight line or grade between manholes.

The sewer pipe shall be bedded on a minimum of 6 inches of stone bedding material.

The trench bottom shall be flat. Holes for bells or couplings shall be dug so that no portion of the bell or coupling will contribute to the support of the pipe. The barrel of the pipe shall be uniformly supported throughout the entire length. Should over digging occur, all loosened material shall be removed and the trench bottom brought back to grade with stone bedding material. Bedding material shall be according to specifications and shall be placed and tamped in a manner satisfactory to the

## **ITEM 603.98XX0007- POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

Engineer. Bedding material in such instances shall be placed at the sole expense of the Contractor.

In areas of rock excavation the pipe shall be bedded on a minimum of 6 inches bedding material.

In areas where unstable trench bottoms are encountered, the trench shall be excavated to an additional depth below the layer of stone bedding material and a layer of stone foundation material placed and graded so as to properly support the bedding material, pipe, and backfill. The depth shall vary according to the actual conditions. Payment for such foundation material shall be as hereinafter specified.

All preformed joints shall be made according to manufacturer's specifications. Where it may be necessary to connect to existing facilities of like or unlike materials, such connection shall be made by use of special manufactured adapters as approved by the Engineer.

The inside of each pipe shall be inspected and all foreign matter, joint material that squeezed through, etc., shall be removed before backfilling. Care shall be taken in placing backfill so that the joints are not loosened or sprung. The backfill shall be packed and tamped into place under the pipe. All loosened or broken joints shall be removed and replaced.

- E) LEAKAGE TESTS - Unless otherwise ordered by the Engineer, all sewers, service connections and sewer laterals, shall be tested for leakage and shall satisfactorily meet the test requirements. No connections to existing sewer laterals shall be made until the leakage requirements are met. The Contractor shall furnish all labor, materials and equipment and shall perform the tests. The Contractor shall make all necessary repairs or replacements and shall repeat the final leakage test(s), until the minimum leakage requirements are met.

Leakage tests shall be made only after backfilling is completed. Two types of tests will be acceptable: (a) Exfiltration Test or (b) Low Pressure Air Test. The type of test used will depend upon the extent and type of installation and shall be as directed by the Engineer.

(a) Exfiltration Test

This leakage test consists of an exfiltration test wherein the main sewer, sewer laterals and manholes are filled with clear water to provide a head of at least 5 ft above the top of the pipe or 5 ft above the level of the groundwater table, whichever is higher, at the highest point of the sewer line under test, and measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test the

## **ITEM 603.98XX0007- POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

line must remain filled with water for at least 24 hours prior to taking measurements, and the actual test period shall not be less than two (2) hours.

For purposes of determining the elevation of the top of the groundwater table, the Contractor shall furnish and install an open-end standpipe of perforated pipe. The standpipe shall be installed at least 24 hours before the line is filled with water. One (1) standpipe shall be installed for each section of sewer line tested. A section of sewer is defined as the length of main sewer, including sewer laterals, between two consecutive manholes. Following successful completion of the leakage tests, the standpipe shall be filled with approved material and the top cut off at least 2 ft below finished grade.

Exfiltration shall be measured by the drop of water level in a standpipe or in one of the sewer manholes. When a standpipe and plug arrangement is used in the upper manhole of a line under test, there must be some positive method of releasing entrapped air in the sewer prior to taking measurements. In the case of sewers laid on steep grades, the length of line to be tested at any one time may be limited by the maximum allowable internal pressure on the pipe and joints at the lower end of the line. The recommendations of the pipe manufacturer shall be followed.

When the level of the groundwater table is of such height that the manholes cannot be used for convenient measuring, or if the vertical distance between the top of the pipe and the manhole rim is less than 5 ft, the Contractor shall test the pipe separately from the manholes utilizing the standpipe method including plugs, hoses, etc., to establish the required head of water. Manholes shall then be tested separately.

The total leakage of any section tested shall not exceed the rate of 30 gallons per mile of pipe per 24 hours per 1 inch of nominal pipe diameter. For purposes of determining the maximum allowable leakage, manholes shall be considered as sections of 4 ft or 5 ft diameter pipe, depending on the type manhole included in the test. The equivalent leakage allowance shall be 5 gallons per manhole per 24 hours for 4 ft diameter manholes, and 6 gallons per manhole per 24 hours for 5 ft diameter manholes.

### (b) Low Pressure Air Test

This leakage test consists of plugging each section of sewer, pressurizing the line with air, and measuring the pressure drop time relationship.

Each end of the section of line to be tested shall be sealed off with inflatable pneumatic or manual plugs which shall hold against the air pressure without external bracing and without movement. Plugs shall have at least two valved connections opening into the pipe section, one for introducing low pressure air and one for

**ITEM 603.98XX0007- POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

connecting an approved air gauge calibrated in .25 psi increments.

Air shall be introduced into the test section to a pressure of 4 psi above the average pressure of any ground water that may be over the pipe. In such ground water areas, the Contractor shall install during the original installation a ½ inch capped pipe nipple through the manhole wall at a level of the top of the lowest pipe. The ground water level shall be determined by clearing the nipple with air and connecting a clear plastic hose to the same and measuring the water level in the hose. The height of the water level in feet above the pipe invert divided by 2.3 shall establish the pounds pressure to be added to all readings.

A minimum of two minutes shall be allowed for the pressure to stabilize during which time the pressure shall not drop more than 0.5 psi. The air supply shall then be disconnected and the time in minutes shall be recorded for the pressure to drop no more than 1 psi. Such time shall not be less than the following:

<u>NOMINAL SIZE</u>	<u>MINUTES</u>
4 NPS	2.0
6 NPS	3.0
8 NPS	4.0
10 NPS	5.0
12 NPS	5.5
15 NPS	7.5
18 NPS	8.5
21 NPS	10.0
24 NPS	11.5
27 NPS	13.0
30 NPS	14.5
33 NPS	16.0
36 NPS	17.5



**ITEM 603.98XX0007 M-POLYVINYL CHLORIDE (PVC) SEWER PIPE & FITTINGS**

**METHOD OF MEASUREMENT:**

The quantity to be paid for under these items will be the number of feet of new sewer pipe (including all necessary connections and fittings) furnished and installed in accordance with the plans, specifications and as ordered by the Engineer.

**BASIS OF PAYMENT:**

The unit prices bid per yard for these items shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work including fittings, plugs, connections, and leakage tests.

Excavation, sheeting, and backfill material will be paid for separately under their respective items. Payment will be made under:

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>UNIT OF</u>	<u>PAYMENT</u>
603.98040007	PVC Sewer Pipe & Fittings	4 NPS	Feet
603.98060007	"	6 NPS	Feet
603.98080007	"	8 NPS	Feet
603.98100007	"	10 NPS	Feet
603.98120007	"	12 NPS	Feet
603.98150007	"	15 NPS	Feet
603.98180007	"	18 NPS	Feet
603.98210007	"	21 NPS	Feet
603.98240007	"	24 NPS	Feet
603.98270007	"	27 NPS	Feet
603.98300007	"	30 NPS	Feet
603.98330007	"	33 NPS	Feet
603.98360007	"	36 NPS	Feet

"Progress payments will be made at the unit price bid for 80 percent of the quantity of pipe installed. The remaining 20 percent will be paid for when the testing of the system has been completed."

**ITEM 603.99010008 - TRASH RACK**

**DESCRIPTION:**

This work shall consist of fabricating and installing trash racks as shown on the plans or as directed by the Engineer.

**MATERIALS:**

Materials used in this work shall meet the following requirements:

Bar Reinforcement, Grade 60	Section 709-01
Galvanizing (Type 1)	Section 719-01
Miscellaneous Metals	Section 715-01
Anchor Bolts, Nuts and Washers	Section 710-23
Expansion Bolt Anchors (if used)	Steel used in the expansion bolt anchors shall meet or exceed the requirements of U.S. Government GSA Specification FF-S-325, Group III, Type 1, or Group VIII, Type 1.

Expansion bolt anchors, when specified, shall be capable of resisting a direct tension loading for a given bolt size as noted in the following table:

**BOLT SIZE (DIAMETER)**

0.236 inch	1012 lb-force
0.314 inch to 0.394 inch	4047 lb-force
0.551 inch to 0.629 inch	8992 lb-force

**CONSTRUCTION DETAILS:**

The contractor shall fabricate and install trash racks as shown on the plan.

Welding work shall be performed in accordance with the requirements of Subsection 203 and 208 of the New York State Steel Construction Manual. All exposed steel shall be galvanized meeting the requirements of Section 719-01 (Type 1).

The contractor will be required to provide shop drawings which shall be subject to approval by the Regional Construction Engineer.

Equipment used to drill holes for expansion bolt anchors shall be approved by the Engineer prior to use. Methods used to drill expansion bolt anchor holes shall be satisfactory to the Engineer. Drilling by means of lubricant will not be permitted. Drilling methods shall not cause damage to the anchoring surface. Any damage caused by the contractor's operations shall be repaired in a manner satisfactory to the Engineer. Holes shall be dry, and shall have all foreign and loose material removed immediately prior to the insertion of the anchor.

**METHOD OF MEASUREMENT:**

The quantity to be paid for will be the number of completed trash racks installed.

**BASIS OF PAYMENT:**

The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work.

**ITEM 605.09020008 - UNDERDRAIN FILTER TYPE 1 (MODIFIED)**

All specification requirements for Item 605.0901 shall apply with the following modifications:

1. The use of crushed gravel or screen gravel as stated in Subsection 605-2.02A Granular Filter Materials will not be allowed.
2. METHOD OF MEASUREMENT

A deduction shall be made for pipes (based on nominal diameters) and other payment items, when the combined cross-sectional area exceeds 1 square foot unless otherwise shown on the plans. No deduction will be made for the cross sectional area of an existing facility.

## **ITEM 609.4000015 - REINFORCED PRECAST CONCRETE PARKING BLOCKS**

**Description:** Under this item, the Contractor shall furnish and place Reinforced Precast Concrete Parking Blocks of the type detailed below at the location indicated on the plans or where directed by the Engineer.

**Materials:** All the provisions of §714-04 Precast Concrete Curb shall apply including those under sampling and testing.

**Construction Details:** The blocks shall be set true to line and grade on the existing pavement.

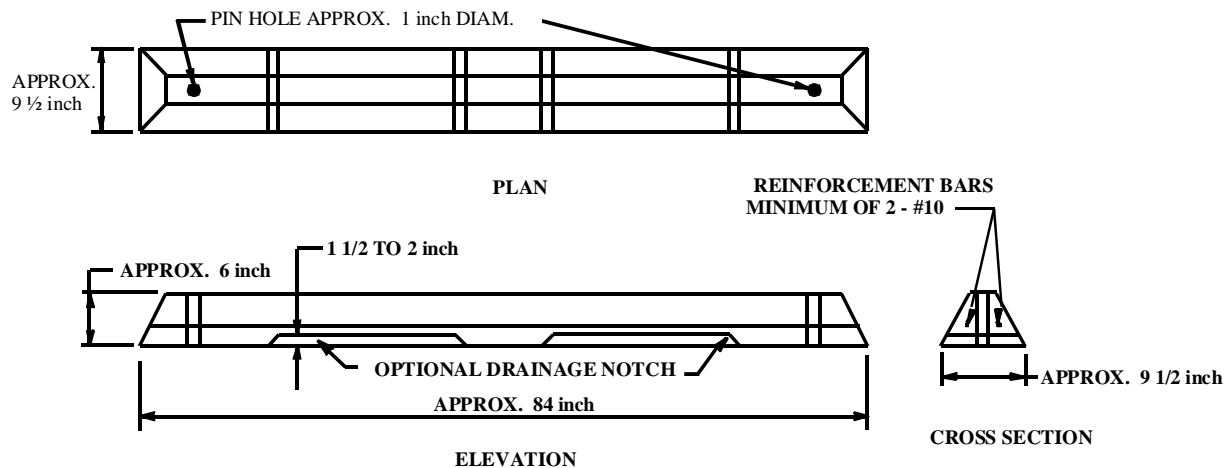
Attachment, to the existing pavement, shall be made with 7/8 inch round anchor pins, 24 inch in length. The pins shall be driven flush with the top of the block.

The blocks shall be placed where indicated on the plans.

The Contractor shall protect the blocks and keep them in first class condition until acceptance of the Contract. Any blocks that are damaged previous to the final acceptance of the work shall be removed and satisfactorily replaced at the Contractor's expense.

**Method of Measurement:** The quantity to be paid for under this item will be the number of blocks placed in accordance with the plans, specifications and orders of the Engineer.

**Basis of Payment:** The unit price bid for each block shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including the anchor pins.



## **ITEM 610.1104XX09 - DECORATIVE STONE MULCH**

### **DESCRIPTION**

This work shall consist of furnishing and placing decorative stone mulch as per and at the locations shown in the contract documents and as directed by the Engineer.

Material requirements for decorative stone mulch, including stone type, size range, color and other design criteria shall be as indicated in a special note in the contract documents titled, "*Decorative Stone Mulch*".

### **MATERIALS**

Decorative stone mulch shall consist of well-graded, tumbled or naturally rounded stone in the stone type, size range and color specified in the contract documents. Stone shall not include thin or elongated particles. Unless otherwise specified, stone type shall not include limestone.

Decorative stone mulch may be stockpiled or bagged. All decorative stone mulch shall be free of material other than stone.

### **Submittals**

Prior to placement, the Contractor shall submit a material sample for approval. The decorative stone mulch will be accepted based on a visual inspection that the material meets the stone type, size range, color and other criteria listed in the contract documents.

### **CONSTRUCTION DETAILS**

The work shall be done in conformity with the lines, grades, thicknesses, and typical sections shown.

Prior to placement, the areas receiving the decorative stone mulch shall be prepared to a smooth surface and free of unsuitable, non-edaphic material, including, but not limited to, rubble, plastic, construction debris, and plant (vegetable) debris.

Decorative stone mulch may be placed on geotextile fabric or permeable weed control fabric; refer to the contract documents for additional information on the use of additional materials with this payment item. Surface preparation, geotextile fabrics, permeable weed control fabrics and any other materials used with this payment item shall be paid for separately.

Decorative stone mulch shall be placed so that the stone mass is well-graded and evenly distributed throughout the specified range (as indicated in the table of payment items). Any material underlying the decorative stone mulch shall not be displaced or worked into the layer of stone mulch.

**ITEM 610.1104XX09 - DECORATIVE STONE MULCH**

**METHOD OF MEASUREMENT**

This work will be measured as the number of cubic yards, measured to the nearest whole cubic yard, of decorative stone mulch furnished and placed, computed from the payment lines shown in the contract documents.

**BASIS OF PAYMENT**

The unit price bid per cubic yard of decorative stone mulch shall include the costs of furnishing all labor, material and equipment necessary to complete the work.

Any excavation, backfill and/or geotextile materials specified as ground surface preparation for the placement of Decorative Stone Mulch shall be paid for separately.

Where XX denotes the stone sizes shown in the table below:

Inclusive Size Range (inches)	XX
¼ - ½	01
½ - 1	02
½ - 1½	03
1 - 2	04
1 ½ - 2 ½	05
2 - 3	06
2 - 4	07
3 - 4	08
2 - 5	09
3 - 5	10
2 - 6	11
3 - 6	12
4 - 6	13

## **ITEM 627.50140008 - CUTTING PAVEMENT**

### **DESCRIPTION:**

The contractor shall cut existing asphalt pavement, concrete pavement, asphalt surface course, or asphalt concrete overlay on concrete pavement at the locations indicated and detailed on the plans and as directed by the Engineer.

### **MATERIALS:**

None specified.

### **CONSTRUCTION DETAILS:**

Existing pavement and overlay shall be cut perpendicular to the roadway surface along neat lines, and to the depth indicated on the plans and typical sections, using appropriate equipment. After the pavement has been cut through, the Contractor may use pry bars, pneumatic tools or other methods, to pry loose the pavement to be removed from the pavement that is to remain. A pavement breaker may be used to break up the pavement to be removed after the pavement has been completely cut through and completely free from the pavement to remain.

When pavement cutting is called for in the Contract documents, if a neat vertical face with minimal shatter is obtained by performing an adjacent operation (such as milling) which eliminates the need to perform a separate pavement cutting operation, payment will be made for both the pavement cutting item and the item for the adjacent operation.

Any existing pavements and curbs not indicated to be removed that are damaged by the contractor's operations, shall be repaired at no additional cost to the State. Pavement cutting that the contractor chooses to do for his/her own convenience shall not receive any additional payment from the State.

### **METHOD OF MEASUREMENT:**

The quantity to be measured will be the number of linear feet of pavement cutting satisfactorily completed.

### **BASIS OF PAYMENT:**

The unit price bid per linear foot of pavement cutting shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

Payment for prying, breaking, removal and disposal of cut pavement shall be made through other appropriate items.

**ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

**DESCRIPTION**

This specification covers the requirements for furnishing and installing complete sanitary sewer manholes as shown on the plans and in accordance with these specifications.

**MATERIALS**

Materials used for the construction of the sanitary sewer manholes shall be as indicated on the plans, and shall conform to the requirements of the following:

- Cast-In-Place Concrete (Class A).....Section 501
- Mortar for Concrete Masonry.....Section 705-21
- Bar Reinforcement, Grade 420.....Section 709-01
- Frames and Grates.....Section 655
- Concrete Brick.....Section 704-02
- Precast Concrete Drainage Units.....Section 706-04

In addition, precast manhole sections shall be of round configuration, constructed in conformance with the details shown in the Contract Documents and the applicable sections of ASTM Designation C478. In case of conflict, the details included in the Contract Documents shall govern. All sections of precast manholes shall be provided with at least three (3) lifting anchors, details of which shall be submitted to the Engineer for approval before casting.

Inlet and outlet provisions for precast manholes shall conform to details included in the Contract Documents.

Manholes constructed of precast concrete with a circular interior are to conform to ASTM designation C478 except that walls of 48 inches diameter barrels shall have a thickness of 5 inches. Joints shall be made with flexible gaskets conforming to ASTM C361.

Concrete for manhole invert fill shall be Class A Concrete.

A. Quality Assurance

1. General

- a. The State reserves the right to inspect and test all precast concrete manhole components, accessories, and joint material upon delivery to the site and/or at the point of manufacture.
- b. All precast concrete manhole sections delivered to the job site shall be clearly marked at the factory with the date of manufacture and the manufacturer's identification. Omission of this information may be cause for rejection of the manhole sections.

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**ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

- c. The State reserves the right, at all times, to have its representative inspect the materials, the processes of manufacture, the records of analysis and tests, and to select the test specimens at the place of manufacture of the precast manhole sections.
- d. The Contractor shall conduct leakage tests in accordance with the requirements specified in the "Leakage Tests" Section of these Specifications.

2. Manufacturer's Testing

- a. All sampling and testing shall be in accordance with Section 501 - Cast-in-Place Concrete (Class A) and Section 706-04 - Precast Concrete Drainage Units.
- b. Manhole components *shall not* be shipped prior to attaining the specified twenty- eight (28) day compressive strength.
- c. Manhole components *shall not* be shipped unless they bear a stamp of approval by the State or as ordered by the Engineer.

B. Submittals

1. Shop Drawings

- a. Shop drawings shall be submitted for all manholes, manhole castings, and manhole accessories. The Contractor shall submit to the Engineer, with such promptness as to cause no delay in the work, or in the work of any other Contractor, seven (7) copies of all shop drawings for all manhole sections and appurtenances specified herein, and no work shall be fabricated until the Engineer's approval has been given. All shop drawings, cuts, catalogs, or other data requiring approval must be submitted to the Engineer by the Contractor and must bear his stamp of approval evidencing that the data have been checked. Drawings, cuts, catalogs, or other data submitted without his stamp of approval will not be considered by the Engineer and will be returned to the Contractor. Likewise, all questions concerning the plans and specifications which require clarification or interpretation shall be submitted in writing to the Engineer through the Contractor.

The Contractor shall make corrections in the drawings required by the Engineer and shall file with the Engineer seven (7) corrected copies. Approval by the Engineer of such drawings shall not relieve the Contractor of responsibility for errors of any sort in shop drawings; or for deviations

## **ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

from plans and specifications unless the Contractor, at the time of submission of said drawings, has given notice to the Engineer of such deviations.

- b. Shop drawings shall include, but not be limited to, the following information:
  - (i) Size and spacing of steel reinforcement.
  - (ii) Wall and slab thickness.
  - (iii) Concrete cover over steel reinforcement.
  - (iv) Joint design between component manhole sections, show all dimensions.
  - (v) Concrete mix design including design compressive strength.
  - (vi) Design of flexible manhole seal assemblies.
  - (vii) Details of manhole ladders, attachments and supports.

### 2. Design Calculations

- a. Design calculations, conforming to the applicable requirements of the American Concrete Institute Standard ACI318, shall be submitted by the Contractor to verify that all components of the manhole will have the required strength to withstand the following loadings:
  - (i) All manholes shall be of sufficient strength to withstand a minimum load produced by the prevailing earth pressure plus hydrostatic pressure in areas subject to ground water.
  - (ii) The maximum Live Load produced by H20-44 Loading as stipulated in the American Association of State Highway Transportation Officials (AASHTO).
- b. All manholes in areas of high ground water or affected by tidal conditions shall be designed with a factor of safety of 1.25 against uplift.
- c. All calculations shall be certified by a Professional Engineer registered in the State of New York.

### C. Castings

**ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

1. All manhole frames and covers shall conform to the requirements of Section 655, "Frames and Grates" of the New York State Standard Specifications and the details shown on the plans.
2. The manhole frames and covers shall be of the adjustable type, as shown on the Contract Plans.

**D. Manhole Collars**

1. General

- a. Brick masonry shall be installed between the precast concrete manhole top slab and the manhole casting as shown on the Contract Plans in order to set the manhole casting at the proper grade.
- b. Precast concrete collar rings may be substituted for brick masonry subject to shop drawing submittal and approval.

2. Brick

- a. All brick shall meet the requirements stated in Section 704-02, "Concrete Brick" of the New York State Standard Specifications.

3. Mortar

- a. All mortar required to complete brick masonry as shown on the Contract Plans shall be in conformance with the requirements stated in Section 705-21, "Masonry Mortar" of the New York State Standard Specifications.

**E. Steel Reinforcement**

1. Steel reinforcement shall be placed in the various sections of precast manholes as shown on the Contract Plans. All steel reinforcement shall meet the requirements specified in Section 709-01, "Bar Reinforcement-Grade 420" of the New York State Standard Specifications.

**F. Precast Concrete Top Slabs**

1. The precast reinforced concrete top slab placed on the top of the manhole chimney shall be manufactured in accordance with the detail shown on the contract plans. The concrete used in the manufacturing of these slabs shall be minimum 4.35 ksi concrete as specified under Section 706-04, "Precast Concrete Drainage Units" of the New York State Standard Specifications.

## **ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

### G. Precast Concrete Chimney

#### 1. General

a. The precast reinforced concrete chimney shall be 48 inches diameter reinforced concrete pipe meeting the requirements of ASTM C478, having a minimum wall thickness of 5 inches.

#### 2. Joints

a. Joints between precast reinforced concrete chimney sections shall be of the bell and spigot type with a preformed plastic sealing compound gasket as specified in the Federal Specifications SS-S-210A. Joints shall be formed so that adjacent manhole sections will fit and seat properly. Gap between sections shall be no more than 3/8 inches.

### H. Precast Manhole Base

#### 1. General

a. Concrete used in the manufacture of precast reinforced concrete manhole bases shall meet all the requirements specified for precast concrete in Section 706-04, "Precast Concrete Drainage Units" of the New York State Standard Specifications.

#### 2. Pipe Connections

a. The precast reinforced concrete manhole base shall be provided with circular openings at the locations and elevations for the proper connection of pipes. The pipe connections shall be sealed with flexible manhole seal assemblies.

b. The flexible manhole seal assemblies shall be installed in accordance with the recommendations of the seal assembly manufacturer and shall conform to ASTM C923-79.

c. Flexible manhole seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

d. The flexible manhole seal assemblies shall be as manufactured by Interpace Corp. (Lock Joint Flexible Manhole sleeve), National Pollution Control Systems, Inc. (Kor-N-Seal) or Press-Seal Gasket Corp. or approved equal.

#### 3. Cast-In-Place Concrete Invert

## **ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

- a. The cast-in-place concrete invert shall be formed within the precast concrete manhole base with 4.35 ksi concrete conforming to the Specifications of Section 501, "Portland Cement Concrete - General" of the New York State Standard Specifications. This concrete shall be Class A.

### 4. Crushed Gravel Foundation

- a. Crushed gravel foundations shall be provided under manhole bases as shown on the contract plans. The crushed gravel shall meet the requirements specified in Section 703-02, "Coarse Aggregates" of the New York State Standard Specifications. This crushed gravel shall be of the size designation as indicated on the plans.

## **CONSTRUCTION DETAILS**

### A. Preparation

#### 1. Excavation

- a. All excavation required for the construction of manholes shall be performed in accordance with Subsection 206-3, "Construction Details" of the New York State Standard Specifications.

#### 2. Dewatering

- a. All measures required to keep the excavation dewatered during pipe installation shall be included under Trench and Culvert Excavation. The Contractor is directed to the proposal for special notes regarding dewatering.

### B. Backfill

1. All backfilling required for the construction of manholes shall be performed in accordance with the requirements of Subsection 203-3.15, "Fill and Backfill at Structures, Culverts, Pipes, Conduits and Direct Burial Cables" of the New York State Standard Specifications.

### C. Precast Manhole Base

1. For precast manhole bases, the area underneath the manhole base shall be excavated to the required elevation. The soil below the base shall not be disturbed. The manhole base shall then be lowered into the trench and checked for proper bearing on the subgrade, proper elevation and orientation to receive the incoming and outgoing sewers at the designated invert elevation. If the invert elevation varies by

## **ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

more than plus or minus ½ inch from the designated invert elevation, the base shall be removed and reset.

2. The concrete invert fill shall be installed following the connection of all sewer pipes to the manhole. The invert fill shall be true to the sewer pipe invert elevations, with smooth channels of uniform cross section and slope, either straight or with a continuous curve between inlet and outlet of pipes.

The concrete invert fill shall be placed in accordance with dimensions and details shown on the Contract Plans.

To eliminate free fall conditions in a manhole resulting from invert elevation differentials between incoming and outgoing pipes, the Contractor shall form and construct suitable channels in the bottom of the manhole connecting the inverts.

### **D. Joints Between Manhole Sections**

1. All joints between the various manhole sections, including chimneys and top slabs, shall be made with a bell and spigot configuration with a preformed plastic sealing compound as specified in the Federal Specification SS-S-210A.

### **E. Manhole Collars**

1. The brick masonry or precast concrete collar be constructed on the Precast Concrete Top Slab to bring the manhole frame and cover to the proper grade in accordance with the detail on the Contract Plans. The minimum height shall be 4 inches and the maximum height shall not exceed 16 inches.
2. Following the placement of the brickwork, a ½ inch layer of Portland cement mortar shall be applied to the exterior surface of the brick and trowelled to a smooth finish.

### **F. Castings**

1. Manhole castings shall be set in a bed of Portland cement mortar on masonry collars as shown in the contract plans. The rim elevation shall be as determined by the Engineer.

### **G. Leakage Tests**

#### **1. Definitions**

- a. For leakage test purposes, a section of sewer line shall be construed as being that portion of a sewer line between two (2) consecutive manholes inclusive

**ITEM 660.97100010 - PRECAST SANITARY SEWER MANHOLE**

of upstream manhole and appurtenances unless otherwise specified.

2. Submittals

- a. The Contractor shall submit a schedule of lines to be tested and the methods and equipment to be utilized in the testing to the Engineer for approval.
- b. In areas requiring dewatering, the Contractor shall submit to the Engineer prior to starting the dewatering pumps, a record of each observation well as specified in the Dewatering Section of these Specifications.
- c. The Contractor shall be required to notify the Engineer not less than forty-eight (48) hours prior to the time he intends to begin testing at any particular location.
- d. Prior to undertaking any repairs, the Engineer's written approval of method and material to be used in the repair shall be secured. Items which in the opinion of the Engineer cannot be repaired shall be replaced.

3. General Parameters

- a. All gravity and pressure sewer lines, including but not limited to pipe, fittings, manholes, risers, stubs, specials and appurtenances shall be tested for water tightness as hereinafter specified.
- b. The Contractor shall furnish all necessary material, equipment, labor and other facilities required to satisfactorily perform the tests and shall make all necessary repairs or replacements and retests as required at his own expense.
- c. In areas requiring dewatering, groundwater observation wells shall be utilized for monitoring ground water levels prior to and during all leakage testing.
- d. The Contractor is warned that the Engineer may refuse to allow exfiltration testing, or void those already underway if, in his judgment, heavy rain or rainwater inflow will distort test results. Retests of the affected lines shall be done at no cost to the County, State or other agency having jurisdiction. No claims for delays will be considered by the County, State or other agency having jurisdiction, in the event testing is suspended by the Engineer, as specified above.

4. Preparation

- a. General

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- (i) All sewer pipes and manholes must be clean prior to any work described in this section. They shall be free from dirt, debris, sand, stones, etc. and accumulated water must be removed.

5. Manholes

- a. The testing of new manholes will be performed using the water exfiltration test only. Air pressure testing on manholes will not be accepted.
- b. Prior to the test, all pipes in the new manhole to be tested shall be plugged. All plugs shall be installed in the presence of the Engineer or his representative. Each new manhole shall be filled with water to a level not less than 24 inches above the exterior crown of the upstream pipe or above the normal groundwater level whichever is higher.
- c. A one (1) hour stabilization period will be permitted to allow for water absorption by the manhole. This stabilization period may be extended with the permission of the Engineer. Water *shall not* be allowed to remain in the manhole overnight. Should the water level during the stabilization period drop below the test level as specified above, the Contractor, in the presence of the Engineer or his representative shall add make-up water for water lost during the stabilization period to increase the water level to the required height for the test.
- d. The actual test period shall begin following the stabilization period. Addition of make-up water will not be allowed once the test has begun. *Any deviation* from the aforementioned will *void* the test.
- e. The test be conducted for a period of five (5) hours. The Engineer or his representative will take three (3) readings of the water level at the beginning of the test period, and another three (3) readings of the water level at the end of the test period. The average of the readings will be used by the Engineer to calculate the leakage quantity.
- f. The maximum allowable quantity of exfiltration from any manhole under test shall not exceed ½ gal per 12 inches diameter of manhole per 12 inches of water depth measured from the invert of the downstream pipe per twenty-four (24) hours.

6. Repairs and Retest



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a. General

- (i) Prior to making any repairs, the Contractor shall submit to the Engineer, in writing, the proposed method of repair and secure his written approval of methods and material to be incorporated in the repair. The Engineer shall be the sole judge as to whether the pipes or manholes shall be repaired or replaced.
- (ii) All repairs and retesting must be made in the presence of a representative of the Engineer and to the satisfaction of the Engineer.
- (iii) Should a section or sections of pipe, or manholes fail to meet the leakage criteria, the Contractor shall at no cost to the County, State, or other agency having jurisdiction, locate the leaks and repair pipe and manholes, as necessary, until the leakage is within the permitted allowance.
- (iv) Regardless of the results of the infiltration test, it is required that all visible leaks be repaired.
- (v) The injection of gel, sealant, or any other product to seal cracks, porous section, or any other structural defect of the pipe or manhole will not be permitted.

b. Retests

- (i) All tests and repairs shall be repeated as many times as necessary, at no cost to the County, State or other agency having jurisdiction, until the requirements hereinbefore specified have been met.

**METHOD OF MEASUREMENT**

The quantity to be measured under this item will be the number of linear feet of height, measured to the nearest tenth of a foot, from the bottom of the bottom slab to the top of the masonry.

**BASIS OF PAYMENT**

The unit price bid per foot shall include the cost of all labor, equipment, and materials necessary to complete the work including flexible gaskets between manhole sections, concrete invert fill, and all necessary testing and any repairs to the manhole required in connection with the sewerage tests on the manhole.

Manhole frames and covers will be paid for separately.

Excavation (dewatering included in Excavation), backfill, crushed gravel, geotextile and any necessary sheeting will be paid for separately.

DUTCHESS STADIUM NEW LEFT FIELD CLUBHOUSE,  
SEATING BOWL, & RESTROOM BUILDING  
COUNTY PROJECT #RFB-DCB-17-22  
FISHKILL, NEW YORK

57-21113-00

BID SET  
08.12.22

## NYS DOT STANDARD SPECIFICATIONS



**Department of  
Transportation**

# **STANDARD SPECIFICATIONS**

(US CUSTOMARY UNITS)

**VOLUME 2 of 4  
SECTIONS 200 - 599**

**CONSTRUCTION  
AND  
MATERIALS**

**May 1, 2022**

50 Wolf Road  
Albany, New York 12232

[www.dot.ny.gov](http://www.dot.ny.gov)

## **INTRODUCTION**

This publication has been prepared to provide a compilation of standard requirements, called Specifications, used by the New York State Department of Transportation for construction contracts. These specifications are written to the Contractor. They define the Contractor's responsibility in meeting each specification, enumerate the Department's expectations and how they are going to measure and pay, and explain what the Contractor is expected to provide.

When this publication, entitled Standard Specifications (USC) and dated as shown on the Title Page, is incorporated by reference into the Department's construction contracts, it is made a part of that contract. The requirements stated herein may be revised or amended from time to time by notes or special specifications or documents of any description that would be furnished as part of a construction contract.

# STATE OF NEW YORK

## DEPARTMENT OF TRANSPORTATION

### ENGINEERING DIVISION

Contained herein are:

General Provisions of Contract;

Contract forms of Proposal, Agreement and Bonds;

General Construction Specifications;

Materials of Construction;

Payment Items

Adopted

by

The Commissioner of Transportation

and Short Titled

## **"STANDARD SPECIFICATIONS" (USC)**

*Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.*

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# Section 200

# EARTHWORK

## SECTION 201 - CLEARING AND GRUBBING

### 201-1 DESCRIPTION

**201-1.01 General.** This work shall consist of clearing, grubbing, removing and disposing of all trees, brush, stumps, fences, debris, and miscellaneous structures not covered under other contract items within the construction area and such other areas as specified or directed. The Contractor shall clear such additional areas within the limits of the right-of-way and easement lines as specified or directed.

**201-1.02 No Burning Requirement.** Materials generated by the work, including construction and demolition debris, shall not be disposed of by burning on or off the site. Off site burning in a permitted solid waste incinerator or in another lawful manner as refuse derived fuel will be permitted.

**201-2 MATERIALS** (Not specified)

### 201-3 CONSTRUCTION DETAILS

**201-3.01 Limits of Work Areas.** The Engineer will establish the limits of areas to be cleared and grubbed, to be cleared but not grubbed, or areas, objects or features that are designated to remain undisturbed. In general, the work areas shall include the road section, stream channels, ditches, temporary approaches to bridges, detours and other areas as shown in the contract documents or directed by the Engineer. The Engineer will designate fences, structures, debris, trees and brush to be cleared where grubbing is not required. Clearing beyond the areas of construction shall be done only where specified or directed.

**201-3.02 Clearing and Grubbing.** During the life of the contract the Engineer may order the clearing of any trees within the R.O.W. that the Engineer determines to be hazardous or dead and unsightly.

The Contractor shall carefully prune all branches of trees less than 16 feet above any part of the roadway and all branches which have been broken or injured during construction. The work shall be done as specified under §614-3.01A Equipment and B. Pruning.

Whenever trees are felled or trimmed on/or adjacent to highways, all wood shall be immediately removed from the roadway or any area that would present a hazard to traffic. Grubbed stumps shall be moved immediately at least 30 feet from the edge of pavement. No trees, tree trunks, stumps or other debris shall be felled, sidecast or placed outside the limits of the road section. No grubbing will be required beneath the embankment where the finished grade will be 6 feet or more above the original ground surface unless otherwise specified in the contract documents. Where trees or existing stumps are cleared and grubbing is not required, the tree trunk or existing stump shall be cut off not more than 6 inches above the original ground surface unless otherwise approved. Exposed stumps not required to be removed, but which are within 30 feet of the edge of the pavement or are in a built-up area, shall be

chipped out to a depth of not less than 6 inches below the finished grade and the holes backfilled if directed by the Engineer. This work shall be completed within one week after start of work on the tree.

### **201-3.03 Disposal**

**A. General.** All wood including grubbed stumps shall be removed from the contract site or otherwise disposed of.

#### ***B. Methods of Disposal of Wood and Brush.***

**1. Disposal (No Burning).** All wood and brush shall be disposed of within fifteen (15) days after cutting or felling unless otherwise approved. No burning of land clearing materials that result from the clearing and grubbing operations, except in a permitted solid waste incinerator or as refuse derived fuel, will be permitted. The Contractor will have the following options or combination of options for disposal of this material:

a. The Contractor shall make every effort to salvage marketable timber as specified in paragraph B4 of this subsection.

b. When permitted by a note in the contract documents, disposable material may be placed at locations approved by the Engineer within the right-of-way but outside of the embankment area.

When permitted by a note in the contract documents, disposable material may be placed in the embankment side slope area. The contract documents will define the embankment side slope area and the procedures for the concurrent construction of the embankment and disposal section.

This type of disposal will require certain preparatory work. Preparation for direct burial of woody materials shall consist of cutting main trunks and limbs and chipping smaller limbs, branches, foliage and brush. Under conditions when disposal space and earth cover are limited in size and quantity, stumps will have to be ranked in size and placed in layers so as to make best use of the space available and the quantity of materials to be buried.

c. The Contractor may bury disposable material off the right-of-way at locations obtained by the Contractor at no expense to the State. Such locations are to be approved in writing by the Engineer. The disposal work will require the same preparatory work as stated in option b. above except that the Engineer may waive such requirements for miscellaneous work which may be accommodated in a satisfactory manner by other methods. The disposal area is to be covered with earth as hereinafter specified.

d. The Contractor may reduce all woody materials to chips and dispose of the chips as specified in paragraph B2 of this subsection.

e. The material may be sent to a refuse derived fuel processing facility or to other processing facility for eventual beneficial re-use as fuel or for other lawful re-use.

Under no circumstances is disposal to be made in swamp or wet lands. When the disposal area is within the embankment section or is formed by flattening the embankment slopes, the elevation of the normal embankment construction shall always equal or exceed that of the disposal area. There is to be absolutely no end dumping of disposable material over the sides of the embankment. All disposal areas are to be finally covered with a minimum of 2 feet of earth and graded to drain properly.

**2. Chipping.** Wood may be reduced to chips by the use of an approved chipping machine or stump grinder. Chips shall be 1/2 inch maximum thickness or of other approved thicknesses.

Chips resulting therefrom may be disposed of by being stockpiled and used as mulch for planting, by distribution on the ground surface in wooded areas within the right-of-way as approved by the Engineer, or by disposal at a location off the contract site satisfactory to the Engineer.

**3. Burying.** No tree trunks, stumps or other debris shall be buried inside the right-of-way limits without the written approval of the Engineer. Disposal areas outside the right-of-way limits shall be approved in writing by the Engineer and shall be acquired by the Contractor at no expense to the State.

**4. Salvage of Marketable Timber.** In the interest of conservation, the Contractor shall make every effort possible to salvage marketable timber produced as a result of clearing operations, provided the amount of timber is great enough to make the hauling practical. In general, marketable timber is construed to mean logs 8 to 16 feet in length, plus appropriate trimming allowance, having a diameter inside the bark, at the small end, of approximately 10 inches. In the event that the Contractor is not successful in salvaging marketable timber, the Contractor shall advise the Engineer, in writing, of the efforts to salvage and indicate the reason why the timber could not be salvaged.

Any wood that is cut up in firewood lengths or other marketable lengths may be neatly piled adjacent to the right-of-way in an area provided by the Contractor for periods in excess of one week but shall be removed prior to completion of the contract.

## **201-4 METHOD OF MEASUREMENT**

**201-4.01 Per Acre.** Payment for Clearing and Grubbing will be made at the unit price bid per acre computed to the nearest one tenth acre.

**201-4.02 Per Lump Sum.** Payment for Clearing and Grubbing will be made on a lump sum basis for work satisfactorily completed. Monthly payments will be made in proportion to the amount of work done as determined by the Engineer.

**201-4.03 Borrow Areas.** Borrow pits or other pit areas from which material is secured shall not be included for measurement of clearing and grubbing.

## **201-5 BASIS OF PAYMENT.**

**201-5.01 Clearing and Grubbing.** Payment will be made at the contract price to furnish all materials, labor and equipment necessary to satisfactorily complete the work as specified. No separate payment will be made for any excavation, backfill or earth cover necessary to complete the work of disposal outside the embankment area nor for the work in handling, storing, rehandling and hauling of disposable material within or outside the right-of-way.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>PayUnit</b>
201.06	Clearing and Grubbing	Lump Sum
201.07	Clearing and Grubbing	Acre

## **SECTION 202 - DEMOLITION OF BUILDINGS AND STRUCTURES**

(Last Revised May, 2022)

**202-1 DESCRIPTION.** This work shall consist of the demolition, removal and disposal of existing buildings; and the demolition, removal and disposal of existing bridge structures, removal and disposal of

steel supported and concrete superstructure supported structural slabs (with and without shear connectors), in accordance with the contract documents, or as directed by the Engineer.

**202-2 MATERIALS.** Not specified.

### **202-3 CONSTRUCTION DETAILS**

**202-3.01 General.** The Contractor shall conduct all demolition and removal operations in accordance with the contract documents and local building codes. The Contractor shall repair or replace in kind sidewalks, curbs, roadway and other materials designated to remain in place which are damaged as a result of the work at no additional cost to the State.

Where a falling hazard of 6 feet or more above a lower level exists to workers, each worker shall be protected from falling by fall arrest systems, or guardrail systems to a height of approximately 42 inches, or by covering openings. All floor or deck openings not used as material drops shall be covered over with materials substantial enough to support the weight of any loads which may be imposed upon them. Such materials shall be properly secured to prevent accidental movement.

When excavation is required, the Contractor shall provide protection for the public in accordance with §107-05K. *Open Excavations and Trenches*. The Contractor shall make provisions to control dust resulting from demolition operations by wetting the work area and debris or other appropriate measures.

**A. Demolition Plan.** Prior to any demolition or removal operations, the Contractor shall conduct an engineering survey, performed by a competent person, of the building, bridge, or other structure to determine its condition and the possibility of collapse of any portion, in accordance with 29 CFR 1926 Subpart T. Bridge data inspection reports will be made available by the Department, where available. Adjacent buildings or structures within 100 feet of the building or structure shall be included in the survey. If the Demolition Plan is required to be sealed by a Professional Engineer, the engineering survey shall be conducted under the direction of a Professional Engineer.

The Demolition Plan for the demolition, removal, or dismantling of a bridge structure longer than 20 feet shall be prepared, checked, and sealed by a Professional Engineer experienced in the design, construction, or demolition of such structures.

The Demolition Plan for a building, other than ordinary wood frame construction of 2-1/2 stories or less shall be prepared, checked, and sealed by a Professional Engineer or an Architect experienced in building design, construction, or demolition. The Demolition Plan for the demolition of ordinary wood frame construction buildings of 2-1/2 stories or less need not be prepared by a Professional Engineer.

The Demolition Plan for the removal of steel supported structural slabs, Type B, shall be prepared, checked, and sealed by a Professional Engineer, in accordance with §202-3.07.

The Demolition Plan for the removal of steel supported structural slabs – Type A, and concrete superstructure supported concrete slabs need not be prepared by a Professional Engineer.

Demolition Plans that are required to be prepared by a Professional Engineer or an Architect shall be submitted to the Engineer 30 calendar days prior to the start of demolition. Unless otherwise noted, all other Demolition Plans shall be submitted to the Engineer 14 calendar days prior to the start of demolition.

The Engineer may return the Demolition Plan if it does not adequately identify and address obvious safety and other identified conditions. The Engineer's failure to return any Demolition for additional studies and recommendations shall not relieve the Contractor from the obligation of preparing an adequate Demolition Plan and conducting adequate engineering surveys that safeguard workers and the public.

When the Demolition Plan is required to be prepared by a Professional Engineer, the Professional Engineer shall prepare the following, as appropriate. When the Demolition Plan is not required to be prepared by a Professional Engineer, the Contractor shall prepare the following, as appropriate:

1. A plan of the work area including roadways, support structures, railroad tracks, canals or streams, both underground utilities and overhead utility lines, and any other information pertinent to demolition.
2. A description and catalog cuts of the type, size, and weight of cranes, heavy equipment, and trucks to be used.
3. A plan of the location of cranes, heavy equipment, and trucks.
4. Identification of components analyzed, with reference to controlling specifications or codes.
5. Identification of strength of materials (or allowable stresses) related to means and methods, within calculations or drawings.
6. Girder stability analysis, including non-composite girder analysis with dead load and equipment loads.
7. Current condition of superstructure and substructure. Indicate whether it is based on site visit and date, or latest inspection report and date.
8. Section loss of all components (including components in the load path), where applicable, both within calculations and on demolition drawings. State whether section loss is assumed percentage based on inspection report and date, or measured section loss based upon field inspection and date.
9. Demolition sequences (including deck removal), with a narrative description. Calculations associated with the Demolition Plan shall be included for each stage. Include saw cut locations.
10. Clear statement of critical assumptions, with guidance on contingency steps if conditions do not match assumptions.
11. The locations and details of supporting members, framing and foundation, etc., necessary to accomplish the partial demolition of a building.
12. Measures necessary to prevent a partial building demolition from affecting adjacent property.

The following shall be identified in the Demolition Plan, but need not be prepared by a Professional Engineer:

13. The locations and details of signs, barricades, curbing, and decking used to cover over holes in the flooring of a building.
14. Details of water diversion plans necessary for the proposed means and methods. Reference any waterway time restriction dates and identify any environmental ground and environmental water protection requirements, including location specific information.
15. Description of ground and/or water protection plans and materials for containment associated with collection of paint waste or other falling debris generated from subsequent cutting/demo operations, or reference to other submittals.
16. Sequence of operations, including Work Zone Traffic Control requirements such as lane closures, required to perform the work.
17. Means and methods to control dust from being objectionable to nearby residents or potentially hazardous to workers.
18. Description of plans for abatement of all identified and impacted asbestos-containing materials.
19. A plan that addresses any necessary stream protection issues including but not limited to water volumes, sediment impact and aquatic disturbance.
20. Copy of written confirmation from scrap metal recycling facility that it can accept any lead-coated or lead/asbestos-coated metal components generated from the project.
21. Copy of NYSDEC C7 NOTIFICATION FOR GENERATORS found at <https://www.dec.ny.gov/chemical/51768.html> for any recycled lead-coated or lead/asbestos-coated metal components that could potentially meet the definition of a hazardous waste (pre-1989 coated structural steel not previously 100% commercially blasted to a SSPC surface preparation standard of SP-10 or SP-5). Any required C7 forms shall be submitted electronically by the contractor to [info.sgg@dec.ny.gov](mailto:info.sgg@dec.ny.gov). Copies shall also be provided to both the Engineer and the Regional Construction Area Supervisor for the project.

**B. Monitoring.** A competent person is defined in 29 CFR 1926, Subpart C as someone who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are or will be unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. If the Demolition Plan is required to be sealed by a Professional Engineer per conditions stated herein, then the monitoring performed by a competent person shall be under the direction of a Professional Engineer.

The competent person shall monitor the on-going structural condition of surveyed buildings and structures prior to and during demolition, by observing them for the presence of excessive vibrations; by measuring and recording the width, extent, and progression of cracks; by measuring and recording the plumbness and integrity of structural elements and bracing; and by making other observations as necessary. If these assessments indicate that potential for collapse of a structure or building exists, the competent person shall undertake measures to ensure safety. If these assessments indicate that the work is causing damage to or degradation of structural condition of a structure or building that is to remain or be relocated, the competent person shall undertake measures to prevent additional damage or degradation from occurring and, as directed by the Engineer, shall undertake measures necessary to reverse the degradation or repair the damage.

During the periods that personnel are required to work on, in, or around a building or structure to be demolished or relocated which is in a damaged or deteriorated condition by fire, flood, explosion, weather, or other cause, its elements shall be adequately braced to prevent collapse.

The findings of monitoring assessments shall be promptly provided to the preparer of the Demolition Plan and to the Engineer, if the Demolition Plan has already been submitted.

**C. Utility Facilities.** The Contractor shall protect existing utility facilities during demolition, or if necessary, they shall be temporarily relocated prior to start of demolition work.

Before any structure or building served with or having utility facilities thereon is demolished, all utility services shall be shut off, capped, or otherwise made safe and controlled outside the building or off the structure, before the general demolition work is started. All severed sewer lines or drains emanating from the building or structure shall be capped or otherwise tightly sealed to prevent the entry of foreign materials into the main sewer or drain.

All electric circuits in any work area that is or may become wet or humid during the work shall be shut down and locked out. If electrical power is required, temporary circuits may be brought into the work area, provided such circuits are ground fault protected.

**D. Paint Removal.** Prior to beginning any paint removal operations, deposits of bird droppings and loosely adhered paint shall be removed by hand via shoveling or scraping.

The Contractor shall comply with the provisions of 29 CFR 1926.62 when working on steel structures coated with lead-based paint. The Contractor shall comply with all applicable regulations controlling the release of lead into the environment. In enclosed spaces, the Contractor shall remove paint for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, or weld, or protect workers with air-line respirators in accordance with the requirements of 29 CFR 1926.354(c). Demolition Plans shall reference special project specific worker safety and health concerns, and protective measures shall be detailed in the Safety and Health Plan.

Prior to beginning any steel removal operations, paint shall be removed for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, or weld using vacuum-shrouded paint removal equipment that removes paint, collects and contains the removed paint material, does not permit release of visible dust or debris, and does not vaporize paint into the atmosphere. Following paint removal work, loose paint material not contained by the paint removal equipment shall be collected by vacuums equipped with high efficiency particulate (HEPA) filters. Disposal of paint waste shall be performed in accordance with Section 571 *Disposal of Paint Removal Waste*.

In cases where the Contractor can clearly demonstrate that alternative work practices and engineering controls comply with applicable OSHA regulations associated with worker safety and

health and applicable USEPA regulations associated with public and environmental protection, exception to the paint removal requirement may be granted by the Department as part of the Demolition Plan review and approval. Demolition Plans that propose the use of hydraulic shears without prior paint removal shall include Environmental Ground Protection and/or Environmental Water Protection in order to minimize potential impacts to the environment and/or the public. Demolition Plans that propose the use of torch cutting without prior paint removal shall include adequate containment and/or engineering controls to minimize potential impacts to the environment and/or the public. The Contractor shall ensure proper respiratory protection for exposures via initial personal monitoring. Interim protection of the workers, as defined by OSHA, shall be provided until exposures are determined. Local exhaust ventilation shall be used during periods of wind stagnation. Workers shall stand upwind from activity and ensure no downwind impacts to other, non-protected individuals, including the public. Torch cutting will not be approved in close proximity to sensitive public receptors, such as schools, pedestrian pathways, or buildings.

**E. Disposal of Materials.** All materials removed under this work, abandoned equipment, and fixtures of any kind remaining on any site after it is released to the Contractor are the property of the Contractor and, except for material other than those of a hazardous nature and materials incorporated into the work, shall be removed and disposed of in accordance with §107-10 *Managing Surplus Material and Waste*.

**F. Hazardous Material.** The Contractor shall remove and dispose of, or otherwise remediate, asbestos, hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous materials in the building or on the property and will be paid separately.

The Contractor shall remove, or otherwise remediate, asbestos materials or other hazardous materials on each structure or building before demolition work begins. If it is not feasible to remediate hazardous materials from a building due to lack of structural integrity, or other unsafe conditions, the Contractor shall obtain a regulatory variance as applicable, and perform controlled demolition in accordance with applicable federal and state regulations.

**202-3.02 Disposal of Buildings.** The Contractor shall demolish buildings designated for disposal and released to the Contractor 30 days or more before the contract completion date in accordance with the contract documents. The Contractor shall demolish buildings on site without the use of explosives, unless approved by the Deputy Chief Engineer (Construction).

Any proposal to allow such building or any portion thereof to remain standing at the site, or to be relocated to another site, will be referred to the Regional Director for approval and shall be accomplished under terms and conditions established by the State.

**A. Unauthorized Entry.** The Contractor shall inspect all buildings released for demolition and shall prevent unauthorized entry to these buildings by boarding up or otherwise blocking potential entrances. If material blocking entrances is removed, the Contractor shall, after determining the building to be vacant, replace the removed material in such a manner as to keep the buildings from being re-entered.

**B. Pedestrian Access.** The Contractor shall maintain and keep safely passable and free from debris, snow and ice, all public walkways adjacent to the properties on which buildings to be demolished are located.

Active entrances to two or more story buildings and active walkways within 8 feet of two or more story buildings being demolished shall be completely protected for a minimum of 8 feet from the face of the building by sidewalk sheds, canopies or other means. Protection shall extend a minimum of 1 foot beyond each side of the building entrances, openings or walkways. Protection shall be designed by a Professional Engineer, and be capable of sustaining a load of 150 psf. No canopy or shed shall be designed to deflect falling material into an area where they could cause harm or injury to person or property.

For single story buildings, these requirements may be waived if the work may be satisfactorily and safely completed without protection.

**C. Removal of Salvaged Materials.** The Contractor shall remove all salvaged materials from the site. The Contractor shall not hold any sales, public or private, of salvaged equipment or material within the right of way. The Department does not guarantee the number of fixtures, quantity or quality of equipment or any other material of value existing in the building to be present upon its release to the Contractor.

**D. Rodent, Insect, and Wildlife Control.** The Contractor shall exterminate rodents and insects in each building so infested, in accordance with the requirements of the City, County or the NYS Department of Health. The Contractor or Subcontractor performing the extermination work shall have at least 5 years experience. If the building or structure to be demolished is inhabited by wildlife, the NYS Department of Environmental Conservation or the local animal control officer shall be contacted and given the opportunity to remove such wildlife before extermination or demolition operations are commenced. If inhabited by domesticated animals, the local animal control officer shall be given the opportunity to arrange for their removal.

Bait shall be placed at least 13 calendar days but not more than 30 calendar days before demolition is started, or at such other times as required by the City or County Health Department. Insects shall be controlled by spraying or fumigating. The Contractor shall seal the building if necessary for the treatment to be effective or to prevent migration of insect, pest, or vermin. Demolition work shall not proceed until the extermination is completed.

If extermination is being conducted because it was ordered by the City, County, or NYS Department of Health, the Contractor shall notify that office that the extermination has been completed and shall obtain their written concurrence that the extermination work was satisfactorily completed.

**E. Demolition of Buildings.** Unless mechanically demolished from the exterior, the demolition of multi-story buildings of more than 2-1/2 stories shall be accomplished story by story without accumulating rubble on the floors of the partially demolished structure. Signs warning of the hazard and of falling materials shall be posted at each level. Glass that will create a hazard if fragmented shall be removed.

If mechanical demolition is used, no worker shall be permitted at any location onto which debris may fall or which may become unstable or collapse as a result of the demolition operations. Only the minimum number of workers necessary for the performance of the work shall be permitted in those locations at other times until such time as the operations are complete and the debris has been removed.

If debris is dropped through holes in the floor without the use of chutes, the area onto which the material is dropped shall be completely enclosed with substantial barricades nominally a minimum of 42 inches high, and placed not less than 6 feet back from the projected edge of the opening above. If a hole is used by machines as a material drop, substantial timber or other curbing shall be securely anchored around the hole. The barricades, but not the curbing, may be moved aside temporarily during periods that the machines are actually using the hole. Barricades shall be promptly restored to their proper locations when the machines have ceased dropping material down the hole. Demolition work and workers shall not be permitted in lower areas until debris handling ceases above.

**F. Partial Demolition of Buildings.** If the work involved consists of demolishing only a portion of a building, the Contractor shall cooperate with the owner(s) of the remaining portion so that inconvenience is minimized.

The Contractor shall close the open portions of the buildings being partially demolished with construction similar to the remainder of the building and shall install supporting members, framing, and foundations to support the remaining structure in accordance with the Demolition Plan. Construction necessary to close the open portions shall meet the local building codes. Structural supports shall be of



similar materials as the existing supporting members to which they frame or with which they share load or shall be compatible with them. The Contractor may use salvaged lumber for sheathing provided that such lumber is sound and suitable. The Contractor shall use new timber and lumber for all other purposes.

**G. Demolition of Party Wall Structures.** If the demolition of one or more units of a group of party wall structures leaves a wall or walls exposed, in accordance with the contract documents, the Contractor shall comply with the following:

1. Furring, plaster, chimneys to be removed, projecting parts, and the like shall be removed.
2. The roof shall be properly flashed, repaired, or otherwise treated to prevent leaks.
3. Walls shall be left in a presentable and sound weatherproof condition compatible in appearance with the remaining building and in conformance with local building codes.
4. Walls shall be made self-supporting, safe and weatherproof with construction similar to or consistent with the remaining building. Supports and bracing shall be installed in accordance with the contract documents.
5. Shoring necessary to prevent damage to adjacent property shall be placed on solid foundation in accordance with the contract documents.

**H. Demolition of Foundations.** After demolition of the structure, the Contractor shall remove the foundation walls to the depth of the lowest cellar floor, break up any cellar floor, remove any walkways or other materials, backfill the hole and grade the site; unless the removal would endanger adjacent utility facilities or infrastructure. If the hole is not backfilled promptly, it shall be protected with substantial fencing and signs in accordance with § 107-05 *Restricted Areas*.

**I. Domestic Sewage Facilities.** Septic tanks, leaching basins, cesspools and other similar facilities associated with buildings being demolished or those that will be abandoned shall be pumped free of septage or sewage, removed, and the resulting hole shall be backfilled in lifts of compacted suitable material. The facilities may be collapsed in place after pumping instead of removal. Septage recovered from the pumping operation shall be handled, transported, and disposed of in accordance with 6 NYCRR Part 364.

**J. Basement Petroleum Storage Tanks.** Aboveground petroleum storage tanks associated with buildings being demolished shall be emptied, cleaned, and removed. Petroleum storage tanks with a capacity greater than 1100 gallons that are regulated by NYSDEC, or are regulated by other local codes, and require closure, shall be emptied, cleaned, and closed in accordance with 6 NYCRR Part 619.3, and closure will be paid for under Section 629 *Petroleum Storage Tank Closure*. Any waste products removed from the tanks or generated during tank cleaning/removal operations shall be disposed of in accordance with §107-10 *Managing Surplus Material and Waste*.

**202-3.03 Relocation of Buildings.** The Contractor shall relocate buildings, to sites designated by the owner and approved by the Department, in accordance with the contract documents. Sites to which the buildings are to be moved will be furnished without cost to the Contractor.

**A. Site Preparation.** The Contractor shall construct all necessary foundations and cellar floors for the relocated building to meet applicable local building codes but not less than equivalent in construction to the existing features. The Contractor shall grade the new site, construct necessary driveways and sidewalks, topsoil and/or seed the area and perform other incidentally required items of work to prepare the site in accordance with the contract documents.

**B. Moving Buildings.** The Contractor shall conduct a precondition survey to establish current condition prior to the move, using written and photographic measures. The Contractor shall move the building safely and in a manner so as to cause the least possible damage to the building and the least possible interference with or inconvenience to its occupant(s). The Contractor shall arrange for any temporary rerouting of overhead lines or relocating guide wires and for the clearance of other obstructions. The Contractor shall repair any damage that may occur to the building, pavement and other features as a result of the move.

**C. Restoration of Service Connections.** The Contractor shall restore necessary gas, electrical, sanitary, water supply and other service connections at the building's final location, at least equivalent in construction to the existing connections, so as to cause the least possible disruption in accordance with the requirements of the Utilities and local building codes, and will be paid separately.

**D. Restoration Work.** The Contractor shall restore exterior portions of the building, including steps, porches, railings, and other appurtenances, to as good and serviceable condition, as existed prior to its relocation, in accordance with local building codes. Any property damaged or destroyed during the execution of the work shall be repaired or replaced at no additional cost to the State.

**E. Demolition of Existing Foundations.** The Contractor shall demolish the existing foundation of any relocated building, including those relocated by the owner in accordance with §202-3.02H *Demolition of Foundations*.

**202-3.04 Dismantling and Storage of Superstructures.** The Contractor shall dismantle and store existing superstructures in accordance with the contract documents. A superstructure is defined as that part of a structure above, supported by, and including the bearings. The Contractor shall carefully remove concrete, paving material and other materials from the existing superstructures so as to prevent damage to superstructures to be stored. The parts of superstructure designated to be stored shall be protected, and stored on site or at the locations designated. All stored members shall be adequately match-marked in order to facilitate reassembly. Any parts of the superstructure designated for storage or to remain which are damaged during the course of the operation or during storage shall be repaired or replaced at no additional cost to the State.

**202-3.05 Removal of Superstructures.** The Contractor shall demolish and remove existing superstructures at the site in accordance with the contract documents. A superstructure is defined as that part of a structure above, supported by, and including the bearings. The removal of steel supported structural slabs where the supporting structural steel is to remain shall be performed in accordance with §202-3.07 *Removal of Steel Supported Structural Slabs*. The Contractor shall obtain the approval of the Deputy Chief Engineer, Structures (DCES) for any proposal to allow such structure or any portion thereof to remain standing on the site or to be relocated to another site.

The Contractor shall designate all areas that could become subject to collapse or that could become unstable as a result of demolition activity as non-access areas, and clearly identify them. The public, workers and equipment with operators shall remain outside these designated non-access areas at all times during demolition operations or at any time the area is subject to potential superstructure collapse.

**202-3.06 Removal of Substructures.** The Contractor shall demolish and remove existing substructures in accordance with the contract documents. A substructure is defined as that part of a structure below the superstructure, such as abutments, piers, and wingwalls. The Contractor shall comply with the appropriate construction details specified in Section 203 *Excavation and Embankment*. Excavations shall be dewatered and kept free from water, snow and ice as necessary. If excavation protection is necessary to protect structures or other improvements, or if the alternatives of laying back slopes or benching are not available, the support system shall be as indicated in the contract documents.

Sheeting or piling shown in the contract documents which is integral with the substructure and is designated to remain in place shall be cut off at the elevations shown. If indicated in the contract documents, existing sheeting or piling shall be extracted. The Contractor may, with the permission of the Engineer, extract sheeting or piling not shown to be extracted or designated to remain in place rather than cutting it off at the elevations shown on the plans, at no additional cost to the State.

Resulting holes shall be backfilled with suitable material placed in lifts and compacted, and the area regraded.

**202-3.07 Removal of Steel Supported Structural Slabs.** The Contractor shall remove steel supported structural slabs in accordance with the contract documents. All concrete and other materials carried by the supporting steel members of the superstructure shall be removed unless the plans specifically indicate removal under another item or that the material is to remain in place. Prior to beginning removal operations, the Contractor shall mark the location of the existing primary structural steel members on the surface of the slab. Prior to beginning any sawcutting of the structural slab in order to facilitate removal, the Contractor shall mark the edges of existing structural steel members in contact with the bottom of the slab on the slab surface, or make other adequate provisions approved by the Engineer to prevent damage to the underlying structural steel.

The Contractor shall protect existing structural steel while removing steel supported structural slabs. Nicks or gouges in existing structural steel to remain caused by demolition operations shall be reviewed by the DCES and the Contractor shall repair those damages in accordance with the Steel Construction Manual (SCM) and the direction of the DCES.

All unpainted structural steel surfaces exposed by concrete removal, against which new concrete will be subsequently placed, shall be cleaned sufficiently to ensure proper bond between the steel and concrete.

**A. Removal of Steel Supported Structural Slabs with Shear Connectors.** The Contractor shall remove all existing spiral shear connectors, so that the remaining cut surface is a maximum 3/4 inch from the surface of the structural steel. Spirals shall be cut in such a manner that the structural steel to remain is not damaged.

The Contractor shall retain existing shear studs undamaged. Existing shear studs removed or damaged during removal of structural slabs, shall be replaced by the Contractor in accordance with the provisions of the SCM, Section 7, Part C *Stud Welding*, at no additional cost to the State.

The Demolition Plan for the removal of steel supported structural slabs with shear connectors shall be either of two types, as described below:

**1. Removal of Steel Supported Structural Slab (with shear connectors) –**

**Type A.** Under this type, the Demolition Plan for the structural slab removal need not be sealed by a Professional Engineer.

**2. Removal of Steel Supported Structural Slab (with shear connectors) –**

**Type B.** Under this type, due to the increased risks of structural instability in this type of removal, the Demolition Plan for the structural slab removal shall be prepared, sealed, and checked by a Professional Engineer.

**B. Removal of Steel Supported Structural Slabs without Shear Connectors.** The Contractor shall remove steel supported structural slabs in accordance with the contract documents. Installation of new shear studs, if required, will be paid for separately.

The Demolition Plan for the removal of steel supported structural slabs without shear connectors shall be either of two types, as described below:

**1. Removal of Steel Supported Structural Slab (without shear connectors) –**

**Type A.** Under this type, the Demolition Plan for the structural slab removal need not be sealed by a Professional Engineer.

**2. Removal of Steel Supported Structural Slab (without shear connectors) –**

*Type B.* Under this type, due to the increased risks of structural instability in this type of removal, the Demolition Plan for the structural slab removal shall be prepared, sealed, and checked by a Professional Engineer.

**202-3.08 Removal of Concrete Superstructure Supported Concrete Slabs.** Concrete slabs shall be removed to expose the tops of the prestressed concrete beams and diaphragms while retaining the tie-in bar reinforcement, which is precast into the prestressed concrete beam and diaphragms. All other reinforcement and wire mesh shall be removed. The concrete slab shall be removed with chipping hammers not exceeding 40 lbs in weight with the bit removed. The Contractor shall exercise care during the execution of the work to avoid damaging or loosening material that is to remain. If the Contractor's operations result in damage to concrete that is to remain, the Contractor shall stop work and make immediate corrections at no additional cost to the State. Any damage caused by the Contractor's operations to material that is to remain shall be repaired or replaced. If the concrete superstructure to remain is cut, or otherwise damaged by Contractor operations, the Contractor shall stop work immediately until a repair procedure is approved by the DCES.

The Contractor may request in writing to the DCES, to mill the top of the deck to a maximum depth of 2 inches, or until the top mat of reinforcing is exposed, whichever is less. The request shall include the specifications for the piece of equipment to be utilized.

**A. Removal of Concrete Superstructure Supported Concrete Slab with Shear Connectors.** The Contractor shall remove concrete superstructure supported concrete slabs in accordance with the contract documents in such a way that the shear connectors to remain are undamaged. Any damage caused by Contractor operations to shear connectors to remain shall be replaced by a method approved by the DCES at no additional cost to the State.

**B. Removal of Concrete Superstructure Supported Concrete Slab without Shear Connectors.** The Contractor shall remove the concrete superstructure supported concrete slab in accordance with the contract documents.

## **202-4 METHOD OF MEASUREMENT**

**202-4.01 General.** Vacant.

**202-4.02 Disposal of Buildings.** The work under disposal of buildings will be measured for payment on a lump sum basis for a specific building.

**202-4.03 Relocation of Buildings.** The work under relocation of buildings will be measured for payment on a lump sum basis for a specific building.

**202-4.04 Dismantling and Storage of Superstructures.** The work under dismantling and storage of superstructures will be measured for payment on a lump sum basis for a specific superstructure.

**202-4.05 Removal of Superstructures.** The work under removal of superstructures will be measured for payment on a lump sum basis for a specific superstructure.

**202-4.06 Removal of Substructures.** The quantity of removal of substructures to be measured for payment will be in cubic yards measured to the nearest whole cubic yard, computed from the payment lines.

**202-4.07 Removal of Steel Supported Structural Slab.** The quantity to be measured for payment will be in square feet of structural slab removed, measured to the nearest whole square foot. Measurements will not make any deductions for openings.

**202-4.08 Removal of Concrete Superstructure Supported Concrete Slab.** The quantity to be measured for payment will be in square feet of structural slab removed, measured to the nearest whole square foot.

## **202-5 BASIS OF PAYMENT**

**202-5.01 General.** Vacant.

**202-5.02 Disposal of Buildings.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Progress payments will be made monthly in proportion to the amount of work completed.

Suitable or select material obtained from other than the demolition site and used to fill foundation holes, and surface restoration will be paid for separately. Water used for dust control or compaction will be paid for separately if a contract pay item for water is included in the contract. Closure of basement petroleum storage tanks will be paid for separately if regulations require the tank to be closed. The cost of asbestos removal, abatement, and disposal will be paid for separately.

The cost of extermination shall be included in the lump sum price bid if the contract documents indicate that extermination work is required, otherwise it will be considered extra work.

**202-5.03 Relocation of Buildings.** The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including excavation necessary at the old or the new building site and water used for dust control or compaction if a contract pay item for water is not included in the original contract bid documents. Extermination shall be included in the lump sum price bid if the original contract bid documents indicate that extermination work is required. Progress payments will be made monthly in proportion to the amount of work completed.

If a property owner, upon agreement with the Department, removes the building, the Contractor will be paid 20% of the bid price for demolition of the existing foundation, walks and other facilities.

Suitable or select material obtained from other than the demolition site and used to fill foundation holes, and surface restoration will be paid for separately.

The work of reconnecting and providing services for the relocated building at its new site will be paid for separately.

**202-5.04. Dismantling and Storage of Superstructures.** The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments will be made in proportion to the amount of work completed. The cost of paint waste disposal will be paid for separately.

**202-5.05. Removal of Superstructures.** The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments will be made in proportion to the amount of work completed. The cost of paint waste disposal will be paid for separately.

**202-5.06 Removal of Substructures.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Excavation and excavation protection required to access portions of the substructure for removal will be paid for separately.

Material obtained from other than the demolition site and used to fill substructure holes and surface restoration will be paid for separately. Water used for dust control or compaction will be paid for separately if a contract pay item for water is included in the contract. The cost of asbestos removal, abatement, and disposal will be paid for separately.

**202-5.07 Removal of Steel Supported Structural Slabs.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting performed in order to facilitate removal.

**202-5.08 Removal of Concrete Superstructure Supported Concrete Slabs.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting performed in order to facilitate removal. No additional payment will be made for removals, repairs or replacements made necessary due to the Contractor's operations.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
202.01nnnn	Disposal of Buildings	Lump Sum
202.03nnnn	Relocating Buildings	Lump Sum
202.11nnnn	Dismantling and Storing Existing Superstructures	Lump Sum
202.12nnnn	Removing Existing Superstructures	Lump Sum
202.19	Removal of Substructures	Cubic Yard
202.2201	Removal of Steel Supported Structural Slabs (with shear connectors) – Type A	Square Foot
202.2202	Removal of Steel Supported Structural Slabs (with shear connectors) – Type B	Square Foot
202.2301	Removal of Steel Supported Structural Slabs (without shear connectors) – Type A	Square Foot
202.2302	Removal of Steel Supported Structural Slabs (without shear connectors) – Type B	Square Foot
202.24	Removal of Concrete Superstructure Supported Concrete Slabs (with shear connectors)	Square Foot
202.25	Removal of Concrete Superstructure Supported Concrete Slabs (without shear connectors)	Square Foot

NOTE: nnnn denotes serialized pay item for each building or structure.

## **SECTION 203 - EXCAVATION AND EMBANKMENT**

(Last Revised January 2020)

**203-1 DESCRIPTION.** This work shall consist of excavation, disposal, placement and compaction of all materials that are not provided for under another section of these Specifications, and shall be executed in conformance with payment lines, grades, thicknesses and typical sections specified in the contract documents.

### **203-1.01 Definitions.**

**A. *Unclassified Excavation.*** Unclassified excavation shall consist of the excavation and disposal of all materials, of any description, encountered in the course of construction, unless otherwise specified in the contract. Estimated limits and descriptions of subsurface deposits and formations which may be shown in the contract documents are supplied as a part of Base Line Data.

**B. *Embankment.*** The embankment is the portion of a fill section situated between the embankment foundation and the subgrade surface, excluding any material placed under another section of these specifications.

**C. *Embankment Foundation.*** The embankment foundation is the surface upon which an embankment is constructed after all work required under §203-3.03A. *Embankment Foundation* has been completed.

**D. *Subgrade Surface.*** The subgrade surface is the surface of the road section upon which the select materials and/or subbase are placed.

**E. *Subgrade Area.*** The subgrade area is that portion of an embankment situated above either of the following, but excluding any material placed under another section of these specifications.

1. A line located 2 ft. below the subgrade surface and extended to the intersection with the embankment side slopes, or
2. The embankment foundation, whichever is higher.

The material and compaction requirements for the subgrade area in embankments are found in §203-2.01A. *Subgrade Area Material* and §203-3.03C. *Compaction*, respectively.

In cut sections, the subgrade area is not defined except where undercut and backfill with a select material item is specified or ordered: in such cases, the payment lines for undercut work shall define the subgrade area.

**F. Embankment Side Slope Area.** The embankment side slope areas are those cross-sectional areas of an embankment situated outside of lines projected downward and outward on a one on one slope from the edges of the subgrade surface to their intersection with the embankment foundation, but excluding any portion lying within a subgrade area.

**G. Topsoil.** See Section 713 *Topsoil*.

**H. Suitable Material.** A material whose composition is satisfactory for use in embankment construction is a suitable material. The moisture content of the material has no bearing upon such designation. In general, any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man made (i.e. recycled) origin, including mixtures thereof, are considered suitable materials. Contaminated material is not considered suitable. Determinations of whether a specific natural material is a suitable material shall be made by the Engineer on the above basis.

Recycled materials that the Department has evaluated and approved for general use shall be considered to be suitable material for embankment construction subject to the conditions for use as determined by the Department. The Regional Geotechnical Engineer and Geotechnical Engineering Bureau are available to provide guidance on the use of such materials. In general, the use of recycled materials must be also sanctioned by the Department of Environmental Conservation, usually in the form of a Beneficial Use Determination (BUD).

Glass from recycling facilities meeting the requirements of §733-05 *Glass Backfill* shall be considered suitable material for embankment construction.

Reclaimed Asphalt Pavement (RAP), and Recycled Portland Cement Concrete Aggregate (RCA) shall be considered suitable materials for embankment construction, subject to the following conditions for use:

RAP - The Contractor shall provide and place RAP conforming to the requirements of §733-06 *Reclaimed Asphalt Pavement for Earthwork and Subbase*.

RCA-The Contractor shall provide and place RCA conforming to the requirements of §733-07 *Recycled Portland Cement Concrete Aggregate*.

Pieces of broken up concrete pavement from on-site pavement removal or in-place recycling (i.e. rubblizing, crack and seat, break and seat, etc.) may be used in embankment construction. Refer to §203-3.03A. *Embankment Foundation* and §203-3.03B. *Embankments*.

**I. Unsuitable Material.** Any material containing vegetable or organic matter, such as muck, peat, organic silt, topsoil or sod, or other material that is not satisfactory for use in embankment construction under §203-1.01H. *Suitable Material* is designated as an unsuitable material. Certain man made deposits of industrial waste, toxic or contaminated materials, sludge, landfill or other material may also be determined to be unsuitable materials, based on an evaluation by the Department's Geotechnical Engineering Bureau and Office of Environment, and the Department of Environmental Conservation.



**J. Borrow.** Borrow is material required for earthwork construction in excess of the quantity of suitable material available from the required grading, cuts and excavations. Borrow may be necessary even though not shown in the contract documents.

**K. Embankment Construction Control Devices.** Embankment construction control devices allow real-time observations of embankment construction to assess the actual performance of the embankment compared to that envisioned in the design phase. Settlement and pore water pressure are common measures of embankment performance. Techniques for monitoring settlement include a settlement rod or a surface settlement gauge. A settlement rod is an optical survey technique to monitor settlement of the embankment surface. The settlement rod(s) establish monitoring point(s) in relation to a reliable bench mark.

A surface settlement gauge is an optical survey technique to monitor settlement of the existing ground surface, below the embankment installation. The surface settlement gauge is installed prior to placing the embankment and extended upwards through the fill.

Pore water pressure monitoring may be used to determine the effective overburden diagrams (the basis of all geotechnical analyses), monitoring consolidation progress of embankments constructed over soft soils, evaluating seepage in natural slopes or earth dams (slope stability), checking the effectiveness of subsurface drainage facilities, or monitoring water well tests.

A piezometer is an instrument which provides measurements of pore water pressure at the elevation of the installed sensor. Pore pressure data is needed in a foundation soil to assess the excess pore water pressure and hence the undrained strength of the soil. Piezometers are used at various depths within cohesive foundation soils. Some piezometers are used in granular foundation soils to assess their drainage behavior.

**L. Proof Rolling.** Proof rolling consists of applying test loads over the subgrade surface by means of a heavy pneumatic-tired roller of specified design, to locate and permit timely correction of deficiencies likely to adversely affect performance of the pavement structure.

**M. Select Granular Fill – Slope Protection.** Select granular fill – slope protection is a material used to protect the grade of a slope from erosion and sloughing from runoff and groundwater seepage. Seepage is the slow movement of water through small openings and spaces in the surface of unsaturated soil into or out of a body of surface or subsurface water. Sloughing is a shallow surface failure caused by erosive removal of supporting material.

Select granular fill – slope protection is highly permeable while also providing sufficient frictional resistance to resist seepage forces and remain in place.

**N. Applying Water.** Under this work, the Contractor shall furnish and apply water for dust control. Moisture control for compaction purposes is the Contractor's responsibility. Water shall not be applied in inclement weather or when the temperature is 32° F or less.

**O. Modifying Cut Slopes and Other Means of Obtaining Borrow.** The Regional Director may approve the modification of cut slopes and other means of obtaining material, which is not part of the contract, so long as provisions are made to prevent unsafe conditions, damage, and nuisances to property, wildlife areas, and haul routes within and outside the contract limits. Such approval may be granted only after review of a written proposal by the Contractor showing the final deposition of the material, the haul route, hauling hours, and provisions necessary to comply with the above. Should unanticipated conditions arise resulting in any unsatisfactory situation, the Engineer shall immediately rescind the approval pending satisfactory correction.

The following procedure shall apply to areas within the R.O.W. limits which are not designated as available sources of borrow by a Special Note in the contract proposal where the Contractor requests and is granted permission to modify slopes to obtain material for use on State contract work

only. The Contractor will be required to reimburse the State with a rebate for the material obtained in these areas. Permission will not be granted to excavate material beyond the design slopes if it is to be used on other than State contract work.

The rebate to be obtained from the Contractor for this material is comprised of 1) A royalty based on the actual value of the excavated material, and 2) A credit for the difference in the Contractor's handling costs if these handling costs have been reduced. The royalty which is to be obtained for the excavated material shall be appropriate for the item for which it is to be utilized and shall be comparable to the current price being paid to purchase similar material in the area.

If the Contractor's handling costs associated with obtaining material from within the R.O.W. limits are greater than those for obtaining material from other acceptable sources, these additional handling costs must be borne by the Contractor. The royalty shall not be reduced to offset any increased handling costs incurred by the Contractor.

If the Contractor's handling costs associated with obtaining materials from within the R.O.W. limits are less than those for obtaining material from other acceptable sources, the differences shall be reimbursed to the State as a credit in addition to the royalty.

The difference in the Contractor's handling cost shall be determined by an analysis based on a comparison of haul lengths, hauling equipment, hauling operation, use of haul roads or public highways, preparation and restoration of the borrow areas, and any other variables involved.

Prior to modifying rock cut slopes, the Geotechnical Engineering Bureau must be consulted. If rock cut slopes are flattened sufficiently to eliminate the need for presplitting, an additional rebate will be necessary.

All special requirements to be fulfilled by the Contractor, at the Contractor's own expense, shall be clearly stated in the agreement. The foregoing requirement of receiving a rebate from the Contractor for material obtained by modification of slopes shall apply only to locations not designated in the Contract Documents.

**P. Winter Earthwork.** Compaction of soil during cold weather is difficult and can be impractical. Water acts as a lubricant aiding in the process of compaction. As the temperature decreases, the water becomes more viscous (less slippery) and inhibits efforts to pack the soil particles together. Eventually, the water becomes ice, at which point compaction is impossible. For this reason, New York State does not permit normal earthwork placement between November 1<sup>st</sup> thru April 1<sup>st</sup> unless there is an approved Winter Earthwork submittal.

Winter Earthwork is defined as construction operations requiring soil compaction performed from November 1<sup>st</sup> thru April 1<sup>st</sup>. The execution of Winter Earthwork requires modifications to compaction procedures, changes to material requirements, and/or additional equipment and structure assembly for controlling the weather effects on the material and existing ground conditions.

Although Winter Earthwork may be performed when the air temperature, ground temperature, or material temperature is at or below 32° F, frozen material will not be placed, nor will fill material be placed on ground frozen to any depth, in any work incorporated into the final product

## 203-2 MATERIALS

**203-2.01 General.** The requirements for select materials and subgrade area materials are described below. All processing operations including washing, removal of oversize material, blending, or crushing shall be completed at the source of the material. The procedure for acceptance or rejection of these materials shall be in conformance with the procedures contained in the geotechnical control procedure “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**A. Subgrade Area Material.** Subgrade area material shall consist of any suitable material having no particles greater than 6 in. in maximum dimension, unless Select Granular Subgrade with the well

graded rock option is used. In that case, refer to §733-13 *Select Granular Subgrade*. If concrete is used, any exposed mesh or rebar shall not exceed 1 in. in length. RAP is also permitted.

**B. Glass Backfill.** Provide backfill material meeting the requirements of §733-05 *Glass Backfill*.

**C. RAP.** Provide backfill material meeting the requirements of §733-06 *Reclaimed Asphalt Pavement for Earthwork and Subbase*.

**D. RCA.** Provide backfill material meeting the requirements of §733-07 *Recycled Portland Cement Concrete Aggregate*.

**E. Miscellaneous.** Necessary fill material for cleaning, grading and shaping the existing roadside section shall conform to the requirements of §203-2.01A, *Subgrade Area Material*.

**203-2.02 Unclassified Excavation and Disposal.** None Specified.

**203-2.03 Embankment In Place.** Provide backfill material meeting the requirements of §733-08 *Embankment In Place*.

**1. Embankment In Place – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Embankment In Place*.

**203-2.04 Select Borrow.** Provide backfill material meeting the requirements of §733-09 *Select Borrow*.

**1. Select Borrow – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Borrow*.

**203-2.05 Select Fill.** Provide backfill material meeting the requirements of §733-10 *Select Fill*.

**1. Select Fill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Fill*.

**203-2.06 Select Granular Fill.** Provide backfill material meeting the requirements of §733-11 *Select Granular Fill*.

**1. Select Granular Fill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Granular Fill*.

**203-2.07 Select Granular Fill Slope Protection.** Provide backfill material meeting the requirements of §733-12 *Select Granular Fill Slope Protection*.

**1. Select Granular Fill Slope Protection – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Granular Fill Slope Protection*.

**203-2.08 Surface Settlement Gauges.** Provide materials for the embankment construction control device surface settlement gauge meeting the requirements of §733-17 *Surface Settlement Gauge*.

**203-2.09 Settlement Rods.** Provide materials for the embankment construction control device settlement rod meeting the requirements of §733-18 *Settlement Rod*.

**203-2.10 Piezometers.** Provide materials for the piezometer installation meeting the requirements of §732-11 *Open Well Piezometer*.

**203-2.11 Applying Water.** Water used for dust control purposes may be obtained from any source.

**203-2.12 Select Granular Subgrade.** Provide backfill material meeting the requirements of §733-13 *Select Granular Subgrade*.

*1. Select Granular Subgrade – Winter Earthwork.* If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Granular Subgrade*.

**203-2.13 Select Structural Fill.** Provide backfill material meeting the requirements of §733-14 *Select Structural Fill*.

*1. Select Structural Fill – Winter Earthwork.* If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

**203-2.14 Sand Backfill.** Provide backfill material meeting the requirements of §733-15 *Sand Backfill*.

### **203-3 CONSTRUCTION DETAILS**

**203-3.01 General.** The Contractor shall remove all soil, rock, and other material, and utilize or dispose of these materials as required by the contract documents. All excavation and embankment work shall be executed to payment lines shown in the contract documents.

All graded earth surfaces outside the roadway limits shall be smoothed and trimmed in reasonably close conformity (6± in.) of true grade. After trimming, the area shall be left in a compact and satisfactory condition, free of large stones or other objectionable materials, as determined by the Engineer.

Earthwork construction operations requiring compaction shall not be performed from November 1<sup>st</sup> thru April 1<sup>st</sup> except with a Winter Earthwork submittal subject to the provision of this Section and approved by the Regional Director or his designated representative. Winter earthwork operations constitute an additional risk to the Department and Winter Earthwork submittals should not be expected to be automatically approved. Winter Earthwork will be subject to the following restrictions:

- Transitioning from the normal construction season to the exempt winter earthwork months between November 1<sup>st</sup> and April 1<sup>st</sup>, the use of standard earthwork materials may be permitted only under the conditions where the air temperature, ground temperature and material temperature are all above 32° F at the time of placement. Modifications to compaction procedures, including but not limited to the use of thinner lifts, may be required when the temperatures are above 32° F but below 40° F at the time of placement.
- Between November 1<sup>st</sup> and April 1<sup>st</sup>, if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork may only proceed using material that meets the requirements of §733-16 *Winter Earthwork* and/or standard earthwork material placement utilizing the modified methods and procedures contained in the approved Winter Earthwork Submittal.

In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on ground that is frozen to any depth regardless of the date.

**A. Winter Earthwork Submittal.** For Contractors choosing to proceed with earthwork construction operations requiring compaction between November 1<sup>st</sup> thru April 1<sup>st</sup>, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, outlining the modifications to the materials and/or methods including the following:

**1. Material Requirements.** The material meets the requirements of §733-16 *Winter Earthwork*. Provide information on material composition and source substitute, if proposed.

**2. Material Placement.** Provide information on the proposed methods for controlling the weather effects on the material and existing ground conditions (i.e. insulation, enclosures, canvas and framework). Devise a plan to be outlined in the Winter Earthwork Submittal such that all snow, ice, and frozen material shall be removed from the surface of the ground on which embankment or backfill material is to be placed, and from the surface under construction before succeeding lifts are added.

**3. Procedures.** Provide verification procedures to ensure the existing ground is not frozen to any depth (e.g. test pits). Provide procedures to address freeze-thaw action in earthwork that has remained idle during temperature fluctuations (e.g. re-roll and seal the surface prior to placement of succeeding lift).

**4. Seasonal Adjustment Acceptance.** Provide acknowledgement of a transition period allowing the continued use of standard earthwork materials between November 1<sup>st</sup> and April 1<sup>st</sup> only under conditions where the air temperature, ground temperature and material temperature are all above 32° F at the time of placement. Provide acknowledgement of the winter earthwork restrictions stating that, if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork will only proceed using material that meets the requirements of §733-16 *Winter Earthwork* and/or standard earthwork material placement utilizing the modified methods and procedures contained in the approved Winter Earthwork Submittal.

Proceed with Winter Earthwork only after receiving written approval by the Regional Director or his designated representative subject to the provisions of this Section.

**B. Scheduling of Work to Minimize Soil Erosion and Water Pollution.** The Contractor shall ensure effective and continuous soil erosion and sediment control throughout the construction period. The Contractor shall prepare and submit for approval, plans and schedules for all excavation, stripping, embankment, fill and grading operations. Such plans and schedules shall include but are not limited to temporary and permanent erosion control measures specified in Section 209 *Soil Erosion and Sediment Control*, Section 610 *Turf and Wildflower Establishment* and Section 612 *Sodding*.

**C. Drainage and Grading.** The Contractor shall provide and maintain slopes, crowns and ditches on all excavation and embankments to ensure satisfactory surface drainage at all times. Ditches and other drainage facilities necessary to remove ponded water shall be constructed as soon as practical to have the work area dry during the progression of work. All existing culverts and drainage systems shall be maintained in satisfactory operating condition throughout the course of the work. If it is necessary to interrupt existing surface drainage, sewers or under-drainage, then temporary drainage facilities shall be provided until the permanent drainage work is complete. Top-of-slope interceptor ditches, where shown on the contract documents, shall be completed before adjacent excavation operations are

begun. In earth cuts, the Contractor shall progress excavation operations in such a manner that the portion of the cut immediately adjacent to the design slope is at least 5 ft. lower than the general level of the cut at all times until the lower payment line is reached.

The construction of these temporary drainage facilities shall be considered as incidental to the construction of the project and no additional payment will be allowed.

Any portion of an embankment or subgrade which has been damaged by the Contractor's equipment during the course of construction, shall be repaired and re-compacted by the Contractor at no additional cost to the State.

Where seepage causes instability of slopes, excavation and backfill or other corrective measures shall be performed as ordered by the Engineer and paid for under the appropriate item. Excavation for the installation of slope protection may be necessary at any time and location throughout the duration of the contract and may not necessarily coincide with the Contractor's performance of the general excavation work.

**D. Suitable Materials.** Moisture content has no bearing on the suitability of material to be used for embankment construction, however, the moisture content of a material may be such that its use will require manipulation. It is the Contractor's responsibility to determine the economics of using, or disposing of and replacing, such materials. Material determined by the Contractor to be uneconomical for use may be disposed of as specified under §203-3.02B. *Disposal of Surplus Excavated Materials* and replaced with other material at no additional cost to the State.

When a contract includes the item "Unclassified Excavation and Disposal", all excavated suitable materials, including the excavation performed under "Structure Excavation" and "Trench and Culvert Excavation," shall become the Contractor's property for disposal or use under another item of these specifications.

**E. Unsuitable Materials.** All excavated unsuitable materials shall be the Contractor's property for disposal as surplus materials under the provisions of §203-3.02B. *Disposal of Surplus Excavated Materials*.

**F. Borrow.** The management of a borrow source and the acceptability of all borrow material shall be subject to the approval of the Engineer at all times. The Contractor shall notify the Engineer at least ten (10) work days in advance of opening any borrow area, and request approval of the source under the pay item involved. Test pits required by the Engineer to evaluate the acceptability and limits of the source, shall be provided by the Contractor at the Contractor's own expense. Concurrent removal of material for more than one pay item from a single source or pit shall be prohibited except with the written permission of, and under such conditions and restrictions as may be imposed by the Engineer. All borrow pits shall be stripped of sod, topsoil and vegetable matter well in advance of any working face. The minimum distance by which stripping shall lead excavation for a given source shall be established by the Engineer to suit local conditions. Where a borrow source is not under direct control of the Contractor or where special conditions exist, the Engineer may waive any of the above requirements and establish alternative provisions for the control and acceptability of borrow.

Ordinary borrow will be accepted for use where the material qualifies under the definition of Suitable Material, §203-1.01H. *Suitable Material*. All borrow placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 *Select Granular Fill* and §203-3.17 *Select Structural Fill*.

**G. Subgrade Area.** Where a subgrade area is defined in an embankment by §203-1.01E. *Subgrade Area*, the material placed shall conform to §203-2.01A. *Subgrade Area Material*, placed and compacted in conformance with §203-3.03B. *Embankments* and §203-3.03C. *Compaction*. Where

longitudinal and transverse changes from cut to fill are encountered in the work, a subgrade transition section shall be provided in conformance with Standard Sheet *Earthwork Transition and Benching Details*. Where a subgrade area becomes defined by §203-1.01E. *Subgrade Area* in a cut section, the materials placed and other details shall be as specified under §203-3.02C. *Proof Rolling in Cut Sections 3. Procedure*, unless otherwise required by the contract documents. Prior to subbase course placement, the surface on which the subbase is to be placed shall be thoroughly compacted to the satisfaction of the Engineer.

**1. Subgrade Surface Tolerance.** After compaction, the subgrade surface shall not be above design elevation at any location.

### **203-3.02 Unclassified Excavation and Disposal.**

**A. Rock Excavation.** Presplitting is required where the design rock slope is 1 vertical on 1 horizontal or steeper and the vertical height of the exposed rock slope exceeds 5 ft. Ripping will not be allowed within 10 ft. of a slope that requires presplitting. Test sections will be required at the outset of presplit drilling and blasting operations for the evaluation of the presplit rock slopes by a Departmental Engineering Geologist. The Contractor will be required to completely expose the presplit rock face in the test section for evaluation prior to any further presplit drilling.

All rock slopes shall be thoroughly scaled and cleaned. For rock excavations involving multiple lifts, scaling of upper lifts shall be completed prior to drilling and fragmenting of lower lifts. Scaled rock slopes shall be stable and free from possible hazards of falling rocks or rock slides that endanger public safety. If, after scaling, such conditions still exist, a determination of the cause will be made by a Departmental Engineering Geologist and if it is determined that the conditions are the result of poor quality work or improper methods employed by the Contractor, the Contractor shall provide approved remedial treatment, at no expense to the State. Such treatment may include, but is not necessarily limited to, laying back the slope, rock bolting, or shotcreting. In no case shall the subgrade be trimmed prior to the completion of the scaling operation at any location.

**1. Presplitting.** Prior to drilling presplitting holes, the overburden shall be completely removed to expose the rock surface along the presplitting line. The methods of collaring the holes to achieve required inclination and alignment shall be approved by the Engineer.

The presplitting holes shall be a maximum of 4 in. in diameter, spaced not more than 3 ft. center to center along the slope, and drilled at the designed slope inclination for a maximum slope distance of 60 ft. When excavation operations are conducted in multiple lifts, the presplitting holes for successive lifts may be offset a distance of not more than 3 ft. for a design slope of 1 vertical on 1 horizontal and not more than 1 ft. for slopes of steeper design; however, a presplitting hole shall not be started inside the payment line. The Contractor shall control the presplit drilling operations by using proper equipment and technique to achieve the design slope and maximum bench between lifts. If presplitting is conducted in lifts, each lift shall be of approximately equal depth. All presplitting holes shall be checked and cleared of obstructions immediately prior to loading any holes in a round. All presplitting holes shall be loaded with a continuous column charge manufactured especially for presplitting which contains not more than 0.35 lbs. of explosive per foot. The top of the charge shall be located not more than 3 ft. below the top of rock. A bottom charge of not more than 3 lbs. of packaged explosive may be used; however, no portion of any bottom charge shall be placed against a proposed finished slope. Each presplitting hole shall be filled with No. 1A crushed stone stemming meeting the gradation requirements of §703-02 *Coarse Aggregate*. The presplitting charges shall be fired with detonating cord extending the full depth of each hole and attached to a trunk line at the surface. Detonation of the trunk line shall be with blasting cap(s) and shall precede the detonation of fragmentation charges within the section by a minimum of 25 milliseconds. Presplitting shall

extend for a minimum distance equal to the burden plus 3 ft. beyond the limits of fragmentation blasting within the section.

**2. Fragmentation Blasting.** Fragmentation holes, or portions thereof, shall not be drilled closer than 4 ft. to the proposed finished slope. Where presplitting is required, fragmentation holes adjacent to the presplitting holes shall be drilled parallel to the presplitting holes for the full depth of the production lift at a spacing not exceeding the spacing of the production pattern. Only packaged explosives shall be used 10 ft. or less from a design slope which requires presplitting regardless of the construction sequence.

Fragmentation charges shall be detonated by properly sequenced millisecond delay blasting caps.

**3. Explosive Loading Limits.** In the absence of more stringent requirements, the maximum quantity of explosives allowed per delay period shall be based on a maximum particle velocity of 2 in./s at the nearest structure to be protected. In the absence of seismic monitoring equipment, the following explosive loading limits shall apply:

***DISTANCE EQUAL TO OR LESS THAN 212 ft. FROM THE NEAREST STRUCTURE***

- a. When the distance from the proposed blasting area to the nearest structure to be protected is 6 ft. or less, no blasting shall be allowed.
- b. When the distance between the blasting area and the nearest structure to be protected is greater than 6 ft. and equal to or less than 15 ft., a maximum of ¼ lb. of explosives per delay period (minimum of 25 milliseconds) blasting cap shall be allowed.
- c. When the distance between the blasting area and the nearest structure to be protected is greater than 15 ft. and equal to or less than 212 ft., a Scaled Distance of 30 ft. shall be utilized to determine the maximum amount of explosive allowed per delay period (minimum of 25 milliseconds) blasting cap. The Scaled Distance Formula is as described below:

$SD = \frac{D}{\sqrt{E_{\max}}}$
<p>where: <math>SD</math> = Scaled Distance  <math>D</math> = Distance from blasting area to nearest structure to be protected in feet</p>

or

$E_{\max} = \frac{D^2}{(SD)^2}$
<p>where: <math>E_{\max}</math> = Maximum pounds of explosive per delay period (minimum of 25 milliseconds) blasting cap</p>

***DISTANCE GREATER THAN 212 ft. FROM THE NEAREST STRUCTURE***

- a. When the blaster elects to utilize more than 50 lbs. of explosive per delay period (minimum of 25 milliseconds) blasting cap, a seismograph shall be employed to monitor the blasting vibrations generated. The initial loading shall be computed using a Scaled Distance of 30 ft. The resulting particle velocity measured by the seismograph shall be evaluated by a



Department Engineering Geologist. The Geologist's evaluation shall be the basis for adjusting the Scaled Distance.

No separate payment shall be made for this work. The cost shall be included in the appropriate excavation item. The above requirements shall in no way relieve the Contractor of liability for any damage incurred as a result of the blasting operations.

**B. Disposal of Surplus Excavated Materials.** Only unsuitable materials, or that portion of suitable material excavated in excess of the quantity required to construct all embankments on the project, shall be considered as surplus.

Where disposal of surplus materials cannot be accommodated within the right of way, the excess shall become the Contractor's property for disposal. Surplus material disposed of within the right-of-way shall be placed in accordance with §107-10 *Managing Surplus Material And Waste*.

**C. Proof Rolling in Cut Sections.** Immediately prior to final trimming of the subgrade surface and placement of subbase materials in cut sections, all areas of the subgrade surface within roadway limits shall be proof rolled according to the requirements of this subsection. This work, and any delays due to this work, shall be considered incidental to the excavation item.

**1. Purpose.** In cut sections, the purpose of proof rolling is to determine the location and extent of areas below the subgrade surface that require corrective undercutting and are not so specified in the contract documents.

**2. Equipment.** The proof roller used in embankment sections, as specified in §203-3.03D. *Proof Rolling in Embankment Sections 1. Equipment*, shall be employed for proof rolling in cut sections except that the roller shall be loaded to achieve a single stress level in operation, using a gross ballasted weight of 30 tons and all tires inflated to 40 psi.

**3. Procedure.** Two complete passes shall be applied over all elements of the area to be proof rolled. Where any portion of the cut subgrade surface other than that which has been damaged by the Contractor's operations fails to provide a satisfactory support for the proof rolling operation, the Engineer may order corrective undercut and backfill work performed. Backfill of undercuts shown in the contract documents or ordered by the Engineer shall be in conformance with §203.3-13 *Select Granular Subgrade*. Where natural soil below this course will not support the weight of the construction equipment, and when ordered by the Engineer, the course shall be placed in one lift. No additional proof rolling shall follow corrective work.

**4. Exceptions.** Proof rolling of the subgrade surface in cut sections will not be required in any area where the subgrade surface is in a rock cut, or where undercut and backfill has been previously performed. The Engineer may order undercutting and backfill without proof rolling of any cut where the need for corrective work, as determined by the Engineer, is obvious without actual proof rolling. The Engineer may also delete proof rolling in any cut section where, based upon a written evaluation by a Departmental Geotechnical Engineer, proof rolling would be detrimental to the work.

### **203-3.03 Embankment In Place.**

**A. Embankment Foundation.** After completion of the work required under Section 201 *Clearing and Grubbing*, and Section 202 *Removal of Structures and Obstructions*, the embankment foundation shall be prepared. Sod and topsoil shall be removed where the final pavement grade is 6 ft. or less above the existing ground surface and in other areas designated in the contract documents or by the

Engineer. Prior to embankment construction and subbase course placement, the surface on which the embankment and/or subbase is to be placed shall be thoroughly compacted to the satisfaction of the Engineer. Unsuitable materials other than sod and topsoil shall be removed to the depths shown in the contract documents or as directed by the Engineer. Underwater areas shall be filled in accordance with §203-3.04 *Select Borrow* or §203-3.05 *Select Fill* and paid for under its appropriate item.

Where embankments are to be constructed over ground that will not adequately support embankment construction equipment, an initial layer of fill may be allowed to form a working platform. The need, manner of construction, and thickness of such a layer shall be subject to approval of the Engineer, and the layer will be permitted only where the lack of support is, as determined by the Engineer, not due to deficient ditching, grading or drainage practices or where the embankment could be constructed in the approved manner by the use of different equipment or procedures. Thicknesses of up to 3 ft. may be permitted for such a layer. Concrete or asphalt slabs may be used at the bottom of such a layer, provided they are placed horizontally.

In locations where embankments are to be constructed on hillsides or against existing embankments with slopes steeper than 1 vertical on 3 horizontal, the slopes shall be benched. Required benches shall be constructed as shown on the Standard Sheet *Earthwork Transition and Benching Details*.

Where old pavement is encountered within 2 ft. of the top of the subbase course, it shall be broken up or scarified.

**B. Embankments.** The embankment shall be constructed of suitable material as defined by §203-1.01H. *Suitable Material*. Embankment material shall not be placed on frozen earth, nor shall frozen soils be placed in any embankments. Embankment material shall be placed and spread in lifts (layers) of uniform thickness, then uniformly compacted as specified under applicable portions of §203-3.03C. *Compaction*. During embankment construction operations, earth moving equipment shall be routed so as to prevent damage to any compacted lift. Damage to any compacted lift at any time during the course of construction, such as rutting under the loads imposed by earth moving equipment, shall be fully repaired by the Contractor at his/her own expense prior to placement of any overlying materials. At the close of each day's work, the working surface shall be crowned, shaped and rolled with smooth steel wheel or pneumatic tired rollers, for positive drainage.

Particles with a dimension in excess of  $\frac{2}{3}$  of the loose lift thickness are designated as oversized particles. Oversized particles shall be removed prior to compaction of the lift and may be placed in the Embankment Side Slope Area.

Pieces of concrete or asphalt may be used provided that the voids between the pieces are completely filled, and the greatest dimension of any piece does not exceed  $\frac{2}{3}$  the loose lift thickness. Exposed mesh or rebar shall not exceed 1 in. in length.

Embankments constructed using rock products or pieces of concrete shall be spread by bladed equipment on each lift to minimize the formation of large voids as the work progresses. The top lift of a rock or concrete fill shall be chinked.

When permitted by a note in the contract documents, stumps, logs, and other materials may be placed in the Embankment Side Slope Area, provided that: 1) such matter is deposited and compacted concurrent with the adjacent embankment, and; 2) any stumps or woody material are covered by not less than 2 ft. of soil beneath the exposed side slope surface.

Glass shall not be placed in contact with synthetic liners, geogrids, geotextiles or other geosynthetics.

## C. Compaction

**1. General Requirements.** It shall be the Contractor's responsibility to properly place and compact all materials in the road section and other locations specified in the contract documents, and to correct any deficiencies resulting from insufficient or improper compaction of such

materials throughout the contract period. The Contractor shall determine the type, size and weight of compactor best suited to the work at hand, select and control the lift (layer) thickness, exert control over the moisture content of the material, and other details necessary to obtain satisfactory results. During the progression of the work, the Department will inspect the Contractor's operations and will permit the work to continue where:

- a.* Lift thickness is controlled and does not exceed the maximum allowed according to the equipment classifications in subparagraph 2. *Compaction Equipment*, of this subsection, and the equipment meets all specified class criteria. Thinner lifts and lighter equipment than the maximum allowed may be necessary for satisfactory results on some materials.
- b.* The compactive effort (number of passes and travel speed) is uniformly applied and not less than that specified for the given equipment class and lift thickness. Higher efforts than the minimum allowed may be necessary for satisfactory results on some materials.
- c.* The Engineer concludes from a visual observation that adequate compaction has been attained, with the exception of backfill at structures, culverts, pipes, conduits, and direct burial cables. However, the State reserves the right to perform density tests at any time. When tests are performed, the results shall indicate that not less than 90% of Standard Proctor Maximum Density is attained in any portion of an embankment, or 95% in a subgrade area, or as specified for other items with a percent maximum density requirement.
- d.* Significant rutting under the action of the compactor is not observed on the final passes on a lift.

Whenever the Contractor's operations do not conform to the above criteria, or requirements contained in other subparagraphs of this subsection, the Engineer will prohibit placement of an overlying lift until the Contractor takes effective corrective action.

As part of the Department's Quality Assurance (QA) program, the Engineer or his representative may verify the adequacy of the compaction at any time through QA testing. When the Engineer determines that QA tests are necessary, the Contractor shall provide any assistance requested to facilitate such tests. Such assistance shall include but will not be limited to excavation and backfill of test pits and holes. This work shall be considered to be incidental construction.

Damage to any compacted lift at any time during the course of construction such as rutting under the loads imposed by earth moving equipment, shall be fully repaired by the Contractor at his/her own expense prior to placement of any overlying materials.

**2. *Compaction Equipment.*** The selection of compaction equipment is the Contractor's responsibility, but shall be subject to meeting the requirements of this subparagraph and approval by the Engineer with respect to its provisions. All compaction equipment shall be marked by a permanently attached manufacturer's identification plate designating the name of the manufacturer, model number and serial number of the machine as minimum identification. This plate shall be installed in a readily visible location. Compaction equipment lacking such an original manufacturer's identification plate, or with altered or illegible plates, will not be recognized as acceptable compaction equipment. Any equipment not principally manufactured for soil compaction purposes and equipment which is not in proper working order in all respects shall not be approved or used. The Engineer will also withhold approval of any compactor for which the Contractor cannot furnish manufacturer's specifications covering data not obvious from a visual inspection of the equipment and necessary to determine its classification.

The term, “pass,” for any type of compactor, shall denote one direct vertical application of compactor effort over all elemental areas of a lift surface. Terms in common parlance, such as “coverage,” “trips,” etc., have no significance, equivalence, or application under these specifications.

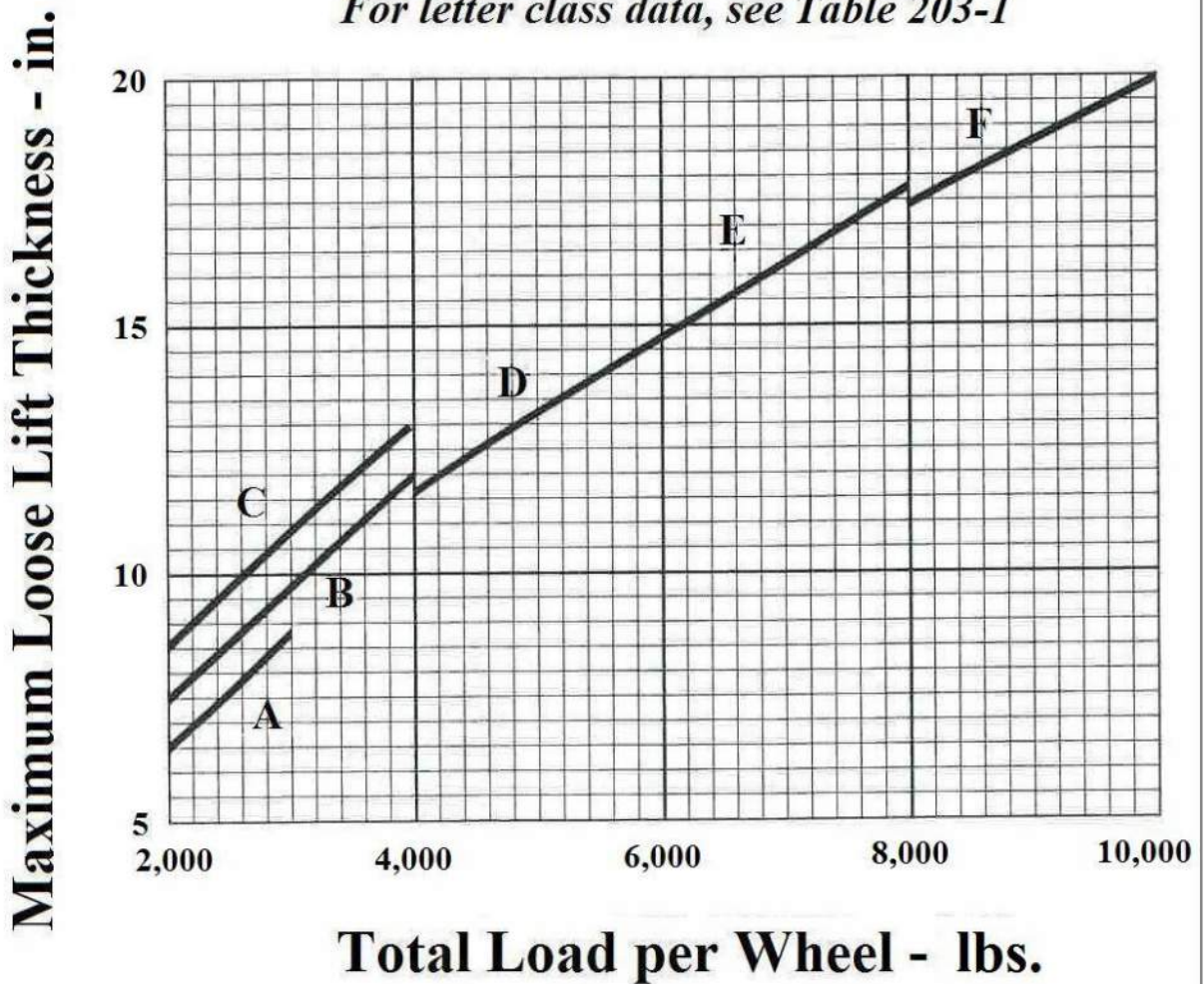
<b>TABLE 203-1 PNEUMATIC-TIRED COMPACTOR CLASSIFICATIONS</b>				
<b>Pneumatic Compactor Class</b>	<b>Tire Requirements</b>			<b>Range of Ballasted Wheel Loads (lbs. per Wheel)</b>
	<b>Tire Size</b>	<b>No. Plys</b>	<b>Inflation Pressure (psi)</b>	
A	7.50 x 15	4	35	2,000 – 3,000
B	7.50 x 15	6	60*	2,000 – 4,000
		10	90*	
C	7.50 x 15	14	130*	2,000 – 4,000
D	9.00 x 20	10	75*	4,000 – 6,000
		12	90*	
E	11.00 x 20	12	90*	6,000 – 8,000
		18		
F	13.00 x 24	18	100*	8,000 – 10,000

\* Inflation pressure for not less than the last two passes on each lift. May be reduced during earlier passes and gradually increased to this level.

*a. Pneumatic-Tired Compactors.* This type of compactor shall be classified for use according to the requirements of Table 203-1. For the lift thickness selected by the Contractor, the minimum class and wheel load which will be allowed on that lift thickness, shall be as shown in Figure 203-1.

**FIGURE 203-1 PNEUMATIC-TIRED COMPACTORS**

*For letter class data, see Table 203-1*



The minimum effort for all pneumatic compactors shall be 6 passes, at speeds up to 12 ft./sec on no more than the first 2 passes, and all subsequent passes at speeds of 6 ft./sec. or less.

**b. Smooth Drum Vibratory Compactors.** This type of compactor is defined as a machine which primarily develops its compactive effort from the vibrations created and is classified for use according to the developed compactive force rating (CFR) per linear inch of drum width.

The CFR is defined as follows:

$$\text{CFR} = \frac{\text{Unsprung Drum Weight (lbs.)} + \text{Dynamic Force (lbs.)}}{\text{Drum Width (in.)}}$$

The unsprung drum weight is the static weight of the drum and appurtenances without any reaction transmitted to the drum from the main chassis of the compactor. The dynamic force produced is dependent on the frequency of vibration, and therefore, CFR ratings shall be determined for the actual operating frequency of the compactor. Approval for vibratory compactors shall be confined, however, to equipment operating at not less than 1100 vpm, nor more than 1500 vpm, and those where the actual dynamic force at the actual operating frequency is at least 2.5 times the unsprung drum weight.

Conversion of manufacturer's published ratings, at a given frequency, shall be made with the following equation:

$$F_2 = \frac{F_1(V_2)^2}{(V_1)^2}$$

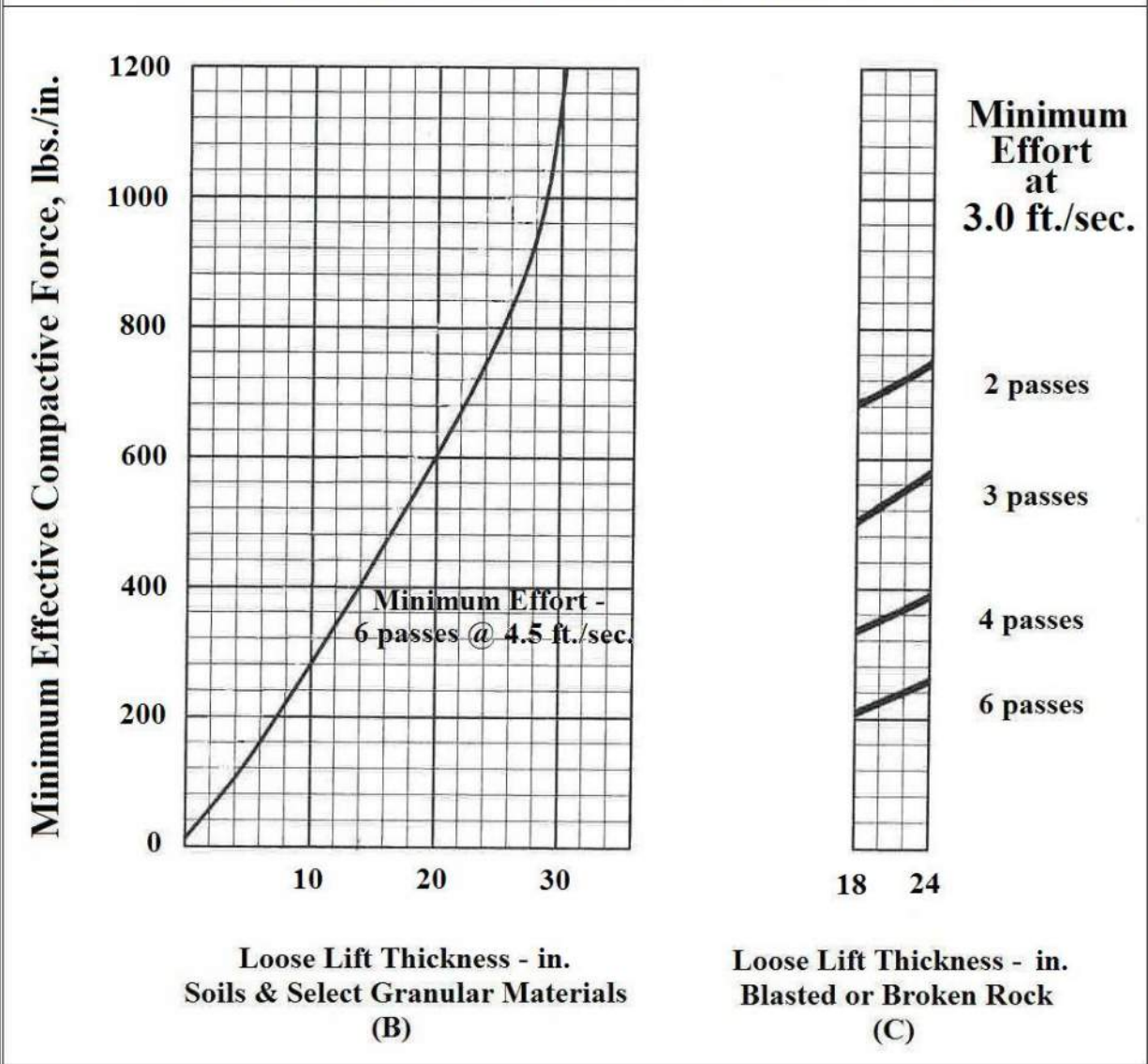
where:  $F_1$  = Dynamic Force at Rated Frequency  
 $F_2$  = Dynamic Force at Operating Frequency  
 $V_1$  = Rated Frequency  
 $V_2$  = Operating Frequency

For the lift thickness selected by the Contractor, the minimum CFR rating and minimum effort on such a lift, shall be as shown in Figures 203-2B&C, respectively. Non-Centrifugal (Vertical force only) types of vibratory compactors shall be approved as above, less 175 lbs./in. before using Figures 203-2 B&C as a minimum number of passes at a single specified speed. An equivalent effort, relating varying numbers of passes to other speeds is given by the equation:

$$\text{Speed X} = \frac{(\text{Specified Speed}) (\text{Min. Passes at Speed X})}{(\text{Specified Min. Passes})}$$

The Contractor may choose to alter the specified minimum pass requirement, provided that speed is adjusted to the value given by this equation and does not exceed 6 ft./sec.

**FIGURE 203-2 VIBRATORY COMPACTORS**



Where vibratory compactors are used on a project, the Contractor shall furnish for the exclusive use of the Engineer, one vibrating reed tachometer per project, plus one additional tachometer for each group of two vibratory compactors in excess of two per project. Tachometers shall have a frequency range adequate to cover operating frequencies of all vibratory compactors used on the project and shall have scale divisions of 50 vpm or less. Tachometers may be placed on the ground surface near the compactor when making readings, or with suitable damping materials interposed, placed directly on the compactor drum frame.

The dispensations permitted under this specification for vibratory compactors are contingent upon proper operation of the equipment at all times during compaction operations. In any instance where the Engineer encounters any problems with operators rolling without

vibration, for any reason, and immediate and effective corrective action is not taken by the Contractor, the Engineer will halt the work until the problem is resolved. If continuing problems of this nature occur, the Engineer may suspend all provisions of this subparagraph and consider the vibratory compactors as smooth steel wheel rollers classified according to their gross weight.

**c. *Sheepsfoot and Segmented Pad Foot Rollers.*** This type of compactor shall be defined as a machine which is primarily designed to compact a lift from the bottom to the top.

The maximum loose layer thickness of the material to be compacted shall be equal to the length of the feet plus 15%. The end area size and configuration of the feet shall be selected by the Contractor to suit the characteristics of soil being compacted.

Where sheepsfoot and segmented pad foot rollers are used, with or without vibration, the number of passes required for job control shall be determined by a jobsite test in which the feet penetrate into the loose lifts and, with further passes, eventually and substantially “walk out” of the layer. This job control shall then be established for that machine, lift thickness and material, provided that adequate moisture control is continuously maintained per §203-3.03C. **Compaction 3. Moisture Control.** Sheepsfoot and segmented pad foot rollers shall be operated at speeds not exceeding 6 ft./sec., when towed and 15 ft./sec. when self-propelled.

**d. *Smooth Steel Wheel Rollers.*** Smooth steel wheel rollers shall be considered as primary compactors on layers whose maximum thickness, after compaction, is 8 in. When so used, the roller shall have a nominal gross weight of not less than 10 tons, exert a minimum force of not less than 300 lbs/in. of width on the compression roll faces, and a minimum of 8 passes shall be applied over each lift with the roller operating at a speed not exceeding 6 ft./sec.

When the Contractor employs smooth steel wheel rollers exclusively for surface compaction, leveling or finishing operations on lifts previously compacted by other types of primary compactors, the above restrictions shall not apply.

This section applies to non-vibratory rollers or vibratory rollers operated in the static mode only.

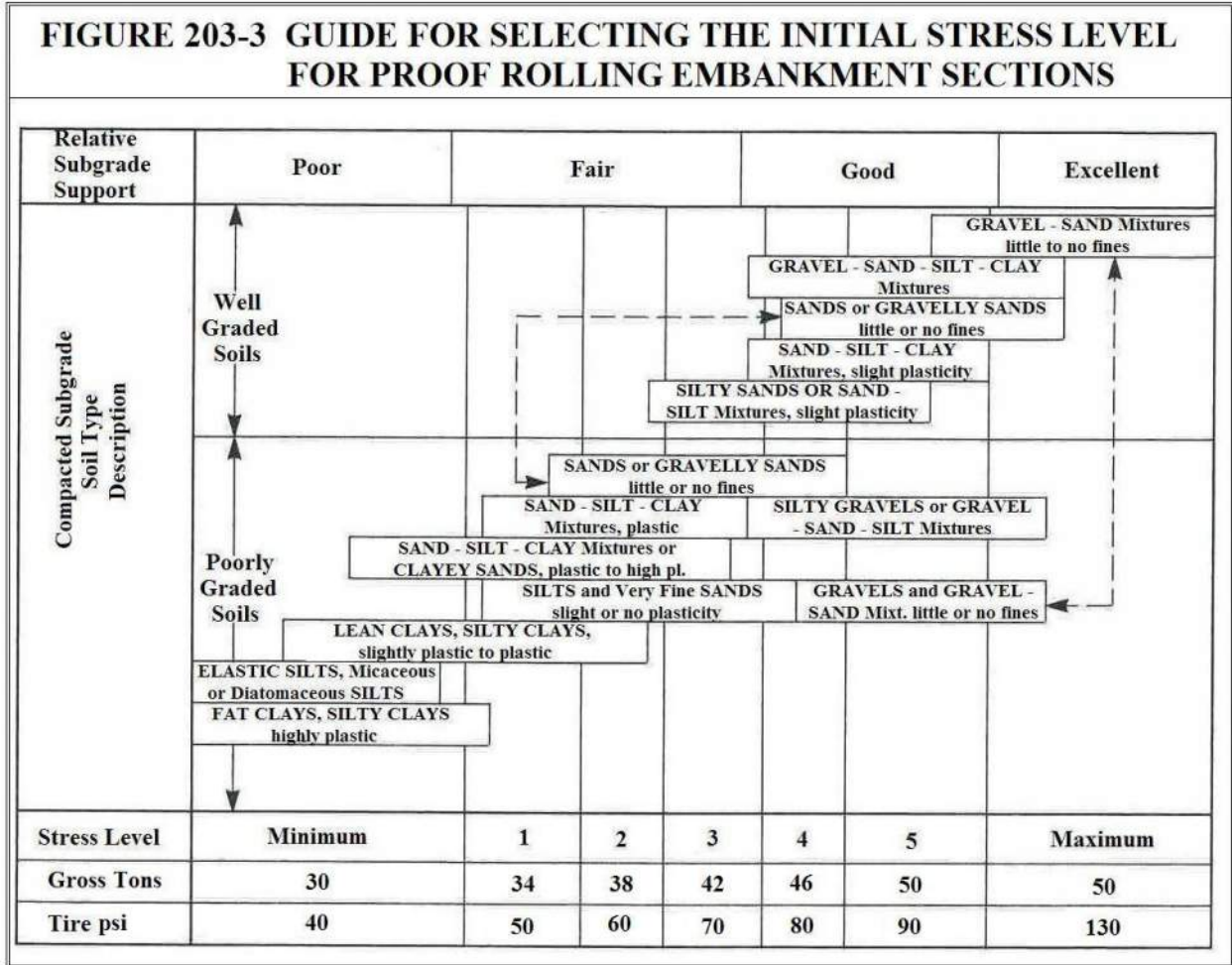
**e. *Other Type of Compactors.*** Compactor types other than those classified above, may be employed by the Contractor, subject to approval by the Engineer of the proposed minimum applied effort (minimum number of passes and travel speed) and maximum lift thickness. Such approval by the Engineer will be based upon the results of appropriate on-site field tests.

**f. *Compaction Equipment for Confined Areas.*** In areas inaccessible to conventional compactors, or where maneuvering space is limited, impactor rammers, plate or small drum vibrators, or pneumatic buttonhead compaction equipment may be used with layer thickness not exceeding 6 in. before compaction. Hand tampers shall not be permitted. The Engineer may approve or reject any of the above described mechanical devices based upon the results of appropriate on-site field tests.

**3. *Moisture Control.*** All fill or backfill material to be compacted, shall be at a moisture content for adequate compaction of that material using the compactor selected by the Contractor to perform the work. The Contractor shall be responsible for determining the appropriate moisture content, and for controlling it within the proper limits as the work is progressed. When water must be added to a material, it may be added on the lift or in the excavation or borrow pit. Water added on the lift, however, shall be applied by use of an approved pressure distributor. Distributors must be approved and documented by the Engineer. Documentation by the Engineer shall be adequate evidence of approval. Water added shall be thoroughly incorporated into the



soil, and the soil shall be manipulated to attain uniform moisture distribution. When the moisture content of a lift about to be compacted exceeds the required amount, compaction shall be deferred until the layer has dried back to the required amount. Natural drying may be accelerated by blending in a dry material or manipulation alone, to increase the rate of evaporation. Increased loose lift thickness caused by blending in a dry material, however, may necessitate a change in compaction equipment and/or methods to meet the minimum provisions of subparagraph 2. *Compaction Equipment* of this subsection.



**D. Proof Rolling in Embankment Sections.** Immediately prior to final trimming of the subgrade surface and placement of subbase materials in embankment sections, all areas of the subgrade surface within roadway limits shall be proof rolled according to the requirements of this subsection. This work, and any delays due to this work, shall be considered incidental to the embankment item.

**1. Equipment.** The proof roller shall consist of a chariot type rigid steel frame with a box body suitable for ballast loading up to 50 tons gross weight, and mounted on four pneumatic tired wheels acting in a single line across the width of the roller on its transverse load center line. The wheels shall be equipped with 18.00 x 24 or 18.00 x 25, 24 ply tires, and shall be suspended on articulated axles such that all wheels carry approximately equal loads when operating over uneven surfaces.

**2. Determination of Roller Stress.** Initially, the gross ballasted weight and tire inflation pressure of the proof roller shall be adjusted to the highest stress level shown in Figure 203-3 based on:

- a. The general description of the subgrade soils.
- b. The estimation of the relative subgrade support within the subgrade soil description range.

The initial roller stress for embankments constructed of rock shall be the maximum level listed in Figure 203-3 (50 Gross Tons, 130 Tire psi).

The roller shall be operated briefly to establish the acceptability of the initial stress level. Proof rolling of the embankment shall be performed at the next lower stress level whenever operation of the roller at a higher stress level is accompanied by consistent lateral displacement of soil out of the wheel paths.

**3. Procedure.** After an acceptable stress level is established, two complete passes of the roller shall be applied over all elements of the area to be proof rolled. Any deficiencies disclosed during the proof rolling operation shall be corrected. Subsidence depressions shall be filled with material similar to the subgrade soil and then compacted in a normal manner. After compaction, these areas shall be proof rolled again. Corrective work shall be judged complete and accepted by the Engineer when all elements of the subgrade surface over a given embankment show a satisfactory uniform response to the proof roller.

**4. Exceptions.** Proof rolling of the subgrade surface in embankment sections will not be required in any area where:

- a. Due to restrictions in available access and/or maneuvering space, use of the proof roller may damage adjacent work;
- b. The proof roller will approach a culvert, pipe or other conduit closer than 5 ft. in any direction.

**203-3.04 Select Borrow.** The management of a select borrow source and the acceptability of all select borrow material shall be in conformance with §203-3.01F. *Borrow*.

Underwater areas shall be filled with select borrow to 2 ft. above the water surface at the time of placement and in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents.

All select borrow placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 *Select Granular Fill* and §203-3.17 *Select Structural Fill*.

**203-3.05 Select Fill.** Underwater areas shall be filled with select fill to 2 ft. above the water surface at the time of placement and in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents.

All select fill placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 *Select Granular Fill* and §203-3.17 *Select Structural Fill*.

**203-3.06 Select Granular Fill.** The type of material to be used in bedding, filling and backfill at culverts, pipes, conduit and direct burial cable shall be in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents. Do not use RAP. Do not use slabs or pieces of either concrete or asphalt.

Fill or backfill material at culverts and pipes shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. *Compaction.* A minimum of 95% of Standard Proctor Maximum Density will be required. When placing fill or backfill around culverts and pipes, layers shall be deposited to progressively bury the pipe or culvert to equal depths on both sides. The limits to which this subsection will apply shall be in accordance with the Standard Sheets or as modified in the contract documents.

Fill or backfill for conduit or cable placed in a trench shall be carefully placed in a horizontal layer to a depth of 6 in. over the top of the conduit or cable. This layer of material shall not be compacted, however, the remaining portion of the trench shall be backfilled in accordance with the preceding paragraph. Where cables or conduits are placed and backfilled by a machine in one operation, the above requirements for backfilling do not apply.

Where sheeting has been used for the excavation, and incremental removal of sheeting is not specified in the contract documents, sheeting shall be pulled when the trench has been backfilled to the maximum unsupported trench depth allowed by 29 CFR 1926.

**203-3.07 Select Granular Fill Slope Protection.** The Contractor shall perform the excavation in accordance with the requirements for “Unclassified Excavation and Disposal” as described elsewhere in these specifications. The Contractor shall then spread material conforming to the requirements given in §733-12 *Select Granular Slope Protection*, in one layer to its full thickness by a method approved by the Engineer. The work shall be performed where shown in the contract documents or where directed by the Engineer in accordance with the Standard Sheets, and details shown on the contract documents. Compaction of the slope protection is not required. Slope Protection shall be either of two types, as described below:

**A. *Select Granular Fill, Slope Protection - Type A.*** Under this type, the Contractor shall furnish and install the slope protection where shown in the contract documents in accordance with the details shown on the Standard Sheets.

**B. *Select Granular Fill, Slope Protection - Type B.*** Under this type, the Contractor shall furnish and install the slope protection where directed by the Engineer in accordance with the details shown on the Standard Sheets.

**203-3.08 Surface Settlement Gauges.** Surface settlement gauges shall be constructed, installed, and maintained where shown in the contract documents and in accordance with the details contained in the geotechnical control procedure “*Settlement Gauges and Settlement Rods*” covering construction, installation, maintenance, and abandonment of these devices.

Where surface settlement gauges are called for, it will be the Contractor's option to install pipe gauges or manometer gauges, unless a definite type is specified in the contract documents. Surface settlement gauges will be accepted for conformance with the specification requirements on the basis of an inspection of the installation by the Departmental Geotechnical Engineer.

**203-3.09 Settlement Rods.** Settlement rods shall be constructed, installed, and maintained where shown in the contract documents and in accordance with the details contained in the geotechnical control procedure “*Settlement Gauges and Settlement Rods*” covering construction, installation, maintenance, and abandonment of these devices.

Settlement rods will be accepted for conformance with the specification requirements on the basis of an inspection of the installation by the Departmental Geotechnical Engineer.

**203-3.10 Piezometers.** Piezometers shall be constructed, installed, and maintained at the locations shown in the contract documents and in accordance with the detailed drawings included in the contract documents.

**203-3.11 Applying Water.** None Specified.

**203-3.12 Select Granular Subgrade.** The type of material to be used in fill or backfill of undercuts shall be in conformance with the details shown in the contract documents or as ordered by the Engineer.

Fill or backfill material shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. *Compaction.* A minimum of 95% of Standard Proctor Maximum Density will be required.

**203-3.13 Select Structural Fill.** The type of material to be used in bedding, filling and backfill at structures shall be in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents or as ordered by the Engineer. Do not use RAP. Do not use slabs or pieces of either concrete or asphalt.

Fill or backfill material at structures shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. *Compaction.* A minimum of 95% of Standard Proctor Maximum Density will be required. When filling behind abutments and similar structures, all material shall be placed and compacted in front of the walls prior to placing fill behind the walls to a higher elevation. The limits to which this subsection will apply shall be in accordance with the Standard Sheets or as modified in the contract documents.

Where sheeting has been used for the excavation, and incremental removal of sheeting is not specified in the contract documents, sheeting shall be pulled when the trench has been backfilled to the maximum unsupported trench depth allowed by 29 CFR 1926.

**203-3.14 Sand Backfill.** The type of material to be used in bedding and filling shall be in conformance with the details shown in the contract documents or as ordered by the Engineer.

Bedding or fill material shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. *Compaction.* A minimum of 95% of Standard Proctor Maximum Density will be required.

## **203-4 METHOD OF MEASUREMENT**

**203-4.01 General.** Quantities for all items of work with payment units in cubic yards will be computed from payment lines shown in the contract documents. Work performed beyond any designated payment line, including any offset required for the construction of presplit rock slopes in lifts, will not be included in the computation of quantities for the item involved.

For any item paid for in its final position, no additional quantity will be measured for payment to make up losses due to foundation settlement, compaction, erosion or any other cause.

Cross-sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown in the contract documents or Standard Sheets, and cannot be reasonably established by the Engineer.

Quantities for benching will be computed for payment from the details and instructions shown on the Standard Sheet *Earthwork Transition and Benching Details*.

The excavation of unsuitable materials designated as topsoil under Section 713 *Topsoil*, will be included in the quantity measured for the appropriate unclassified excavation item, without distinction..

Where the item, "Embankment in Place," is designated for the project by the proposal, all borrow of ordinary suitable materials shall be incidental to the work of that item.

**203-4.02 Unclassified Excavation and Disposal.** Unclassified excavation and disposal will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the original position for all excavation within right-of-way limits. No deduction shall be made for any pipes, culverts, structures, or other obstructions, unless these are measured for payment under another contract item. Excavation for borrow of suitable materials for embankment construction, shall not be included in the computation for this work.

**203-4.03 Embankment in Place.** Embankment in place will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position. Any additional quantity of material required to compensate for embankment settlement shall not be included in the measurement of this item. The quantities of embankment will exclude the total volume of pipes, culverts, other roadway items, and granular backfill within the payment lines for such granular backfill.

**203-4.04 Select Borrow.** Select borrow will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the original position.

**203-4.05 Select Fill.** Select fill will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position.

**203-4.06 Select Granular Fill.** Select granular fill will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft<sup>2</sup> unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

**203-4.07 Select Granular Fill Slope Protection.** Select granular fill slope protection will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final position.

**203-4.08 Surface Settlement Gauges.** Surface settlement gauges will be measured by the number of devices satisfactorily installed.

**203-4.09 Settlement Rods.** Settlement rods will be measured by the number of devices satisfactorily installed.

**203-4.10 Piezometers.** Piezometers will be measured by the number of devices satisfactorily installed.

**203-4.11 Applying Water.** The unit of measurement of water will be one pressure distributor per calendar day, denoted hereafter as one p.d.d., for dust control. Where the Contractor works in more than one separate and distinct shift per calendar day, each shift shall be considered as one p.d.d. A single shift plus overtime work, however, shall be considered as one p.d.d. The quantity thus determined shall be applied directly as the quantity to be paid for where the distributors used have a capacity of 3,000 gal. or less.

Provided that the Engineer determines that the total operating distributor capacity (number and sizes of all distributors) employed is reasonably commensurate with the needs for water application, additional payment will be allowed for distributors exceeding 3,000 gal. in capacity as follows:

Distributor Capacity	Pressure Distributor per Calendar Day Adjustment
3,000 gal. < distributor capacity < 5,000 gal.	p.d.d.'s will be multiplied by 1.5
5,000 gal. ≤ distributor capacity	p.d.d.'s will be multiplied by 2.0

No additional quantity shall be measured for payment for compaction purposes.

**203-4.12 Select Granular Subgrade.** Select granular subgrade will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position.

**203-4.13 Select Structural Fill.** Select structural fill will be measured in cubic yards, measured to the nearest whole cubic yard, in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft<sup>2</sup> unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

**203-4.14 Sand Backfill.** Sand backfill will be measured in cubic yards, measured to the nearest whole cubic yard, in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft<sup>2</sup> unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

## **203-5 BASIS OF PAYMENT**

**203-5.01 General-All Items.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment as necessary to complete the work, except where specific costs are designated or included in another pay item of work. Incidental costs, such as acquisition of borrow pits or material outside of the right-of-way, rock drilling and blasting, compaction and special test requirements, stockpiling and re-handling of materials, precautionary measures to protect private property and utilities, to form and trim graded surfaces, proof rolling, re-proof rolling, corrective work disclosed by proof rolling and any delays caused by this corrective work, shall be included in the unit price of the pay item where such costs are incurred. The exception is that corrective work ordered in cut sections based on an evaluation of proof rolling will be paid for under the appropriate excavation and backfill items.

Quantities for any additional items of work or substitution of material in accordance with the approved Winter Earthwork submittal shall be furnished at no cost to the State.

**203-5.02 Unclassified Excavation and Disposal.** The provisions of §203-5.01 *General-All Items* apply including the following:

The unit price bid shall cover all costs of required excavation within the right of way limits, and all costs of disposal if the excavated materials are not used under another pay item.

**203-5.03 Embankment In Place.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.04 Select Borrow.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.05 Select Fill.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.06 Select Granular Fill.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.07 Select Granular Fill Slope Protection.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.08 Surface Settlement Gauges.** The provisions of §203-5.01 *General-All Items* apply including the following:

The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed, 75% of the item unit price will be paid. The remaining 25% will be paid when each device has been properly maintained and is abandoned according to the procedures contained in the geotechnical control procedure “*Settlement Gauges and Settlement Rods*”. Unless otherwise specified in the proposal, the unit price shall also include the costs of removal.

**203-5.09 Settlement Rods.** The provisions of §203-5.01 *General-All Items* apply including the following:

The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed, 75% of the item unit price will be paid. The remaining 25% will be paid when each device has been properly maintained and is abandoned according to the procedures contained in the geotechnical control procedure “*Settlement Gauges and Settlement Rods*”. Unless otherwise specified in the proposal, the unit price shall also include the costs of removal.

**203-5.10 Piezometers.** The provisions of §203-5.01 *General-All Items* apply including the following:

The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed and the device placed in satisfactory operation, 75% of the unit price will be paid. The remaining 25% will be paid when all earthmoving and slope work is completed in the vicinity of each installation. Any installation rendered inoperative due to damage by construction equipment after partial or full payment, shall be immediately repaired or the full amount of such payment shall be deducted from other monies due the Contractor under the contract.

**203-5.11 Applying Water.** The unit price bid per one operating pressure distributor per calendar day for applying water shall include the costs of furnishing all labor, material and equipment necessary for dust control.

**203-5.12 Select Granular Subgrade.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.13 Select Structural Fill.** The provisions of §203-5.01 *General-All Items* apply.

**203-5.14 Sand Backfill.** The provisions of §203-5.01 *General-All Items* apply.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
203.02	Unclassified Excavation and Disposal	Cubic Yards
203.03	Embankment In Place	Cubic Yards
203.05	Select Borrow	Cubic Yards
203.06	Select Fill	Cubic Yards
203.07	Select Granular Fill	Cubic Yards
203.0801	Select Granular Fill, Slope Protection - Type A	Cubic Yards
203.0802	Select Granular Fill, Slope Protection - Type B	Cubic Yards
203.10	Surface Settlement Gauges	Each
203.12	Settlement Rods	Each
203.13	Piezometers	Each
203.1601	Applying Water	P.D.D.

203.20	Select Granular Subgrade	Cubic Yards
203.21	Select Structural Fill	Cubic Yards
203.25	Sand Backfill	Cubic Yards

## SECTION 204 - FLOWABLE FILL

**204-1 DESCRIPTION.** The work shall consist of mixing and placing flowable fill at the locations shown in the contract documents.

**204-1.01. Controlled Low Strength Material.** Controlled Low Strength Material (CLSM) is an acceptable alternative to compacted soil backfill in confined spaces. CLSM consists of cement, water and, at the Contractor's option, fly ash, aggregate or chemical admixtures in any proportions such that the final product meets the strength and flow consistency requirements included in the specification. The mix is proportioned to be self leveling and does not require compaction. It is much lower in strength than concrete, making future excavation possible.

**204-1.02. Lightweight Concrete Fill.** Lightweight Concrete Fill is an engineered geotechnical material with a unique strength / density relationship which can be used to reduce loads on soft foundation soils, buried structures, or against retaining walls. Lightweight Concrete Fill consists of a Portland cement matrix containing uniformly distributed, non-interconnected air voids introduced by a foaming agent. The flowability and cementitious properties provide a product that is self leveling and does not require compaction.

### 204-2 MATERIALS.

**204-2.01 Controlled Low Strength Material.** Provide backfill material meeting the requirements for CLSM as stated in §733-01 *Flowable Fill*.

**204-2.02 Lightweight Concrete Fill.** Provide backfill material meeting the requirements for Lightweight Concrete Fill as stated in §733-01 *Flowable Fill*.

### 204-3 CONSTRUCTION DETAILS.

#### 204-3.01 Controlled Low Strength Material.

**A. CLSM Submittal.** Submit to the Engineer (1) a mix design, with certified test results supplied by a qualified independent testing laboratory for the CLSM verifying the unconfined compressive strength meets the requirements of the specification, and (2) the methods of installation to be employed. Include in the CLSM placement sequence, a procedure to account for subsidence during the settling and curing process.

**B. CLSM Production.** Mix the materials at a stationary mixing plant which is either a continuous or a batch type plant. A batch is defined as the amount of material that can be mixed at one time. Design the mix of materials to accurate proportions, either by volume or by weight, so that when the materials are incorporated in the mix a thorough and uniform mix will result.

If the CLSM can be placed within 30 minutes of the end of mixing, then open haul units may be used for transport. If it cannot be placed within 30 minutes after the end of mixing, it must be transported by a rotating drum unit capable of 2-6 rpm.



For work involving quantities of CLSM less than 2.5 yd<sup>3</sup>, the Contractor may use a small portable mixer. Provide a mixer capable of mixing CLSM that has the specified unconfined compressive strength and flow consistency. Mix all components so as to produce a uniform product.

**C. CLSM Placement - General.** Do not place CLSM that is frozen, or place CLSM on frozen ground. Do not expose CLSM to freezing temperatures until after it has gained its requisite strength, abiding by the *Provisions for Curing in Cold Weather* in Section 555 *Structural Concrete*.

If the CLSM is to be placed via pumps, the placement sequence shall be such that the equipment is able to access the entire volume to be filled without separating the mixture.

Keep CLSM encapsulated with soil or protected by other means so as to prevent erosion and environmental degradation.

**D. CLSM Placement – at Structures, Culverts, Pipes, Conduits and Direct Burial Cables.** Place the CLSM in accordance with the installation details shown on the Standard Sheet.

When placing CLSM for pipe backfill, discharge the material onto the top and at the center of the pipe.

Do not place CLSM in contact with aluminum pipe, including connections, fixtures, etc., unless the aluminum has been thoroughly coated with Zinc Chromate Primer, §708-04 *Zinc Chromate Primer*, or an equivalent alternative as approved by the Materials Bureau.

Do not place CLSM containing fly ash in direct contact with cast iron or ductile iron pipes, fittings or appurtenances.

In situations where CLSM is used as backfill around pipe, take precautions to counteract the pipe's buoyancy.

**E. CLSM – QA Testing.** The Department maintains a Quality Assurance (QA) program for CLSM. The Department will sample and test specimens of the CLSM during placement to compare its properties to the specification requirements and verifying the spread diameter and unconfined compressive strength of the in-place material. The QA program provides oversight of the Contractors Quality Control (QC) process, to reveal changes which may occur in the approved mix design.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to meet the requirements of the specification for the type(s) identified in the contract documents. No action will be taken.
2. The properties are shown to be outside the requirements of the specification for the type(s) identified in the contract documents.
  - a. If the results are within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the material may remain in-place contingent upon an agreed credit. If a credit cannot be agreed upon, the scenario reverts to 2.b.
  - b. If the results are not within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the entire lift (and all overlying lifts) of material will be removed and replaced at the Contractor's expense.

### 204-3.02 Lightweight Concrete Fill.

**A. Lightweight Concrete Fill Submittal.** Submit to the Engineer (1) a mix design, with certified test results supplied by a qualified independent testing laboratory for the Lightweight Concrete Fill verifying the wet cast density and unconfined compressive strength meets the requirements of the specification for the type(s) identified in the contract documents, and (2) the methods of installation to be employed.

**B. Lightweight Concrete Fill Production.** Generate foam in accordance with the manufacturer's recommendations for inclusion into the mix.

Mix the materials at a stationary mixing plant which is either a continuous or a batch type plant. A batch is defined as the amount of material that can be mixed at one time. Design the mix of materials to accurate proportions, either by volume or by weight, so that when the materials are incorporated in the mix, a thorough and uniform mix will result.

Locate equipment such that the mixed product is capable of being pumped into place properly.

**C. Lightweight Concrete Fill - Placement.** A representative of the supplier of the foaming agent shall be on site during the initial placement and at such times as requested by the Engineer to advise the Contractor on his operation. The lightweight concrete fill shall be placed in lifts not to exceed 24 in. unless otherwise approved by the Engineer. Subsequent lifts shall be placed only after a minimum 12 hour waiting period has been observed.

At the end of each pour, exposed surfaces shall be roughened with a stiff broom or scored with a tool. The Lightweight Concrete Fill shall be placed on supporting surfaces which have been cleaned of loose debris, sand, dust, or other foreign materials to the satisfaction of the Engineer.

Do not place Lightweight Concrete Fill that is frozen, or place Lightweight Concrete Fill on frozen ground. Do not expose Lightweight Concrete Fill to freezing temperatures until after it has gained its requisite strength, abiding by the *Provisions for Curing in Cold Weather* in Section 555 *Structural Concrete*.

**D. Lightweight Concrete Fill – QA Testing.** The Department maintains a Quality Assurance (QA) program for Lightweight Concrete Fill. The Department will sample and test specimens of the Lightweight Concrete Fill material during placement to compare its properties to the specification requirements and verifying the wet cast density and unconfined compressive strength of the in-place material. The QA program provides oversight of the Contractors Quality Control (QC) process, to reveal changes which may occur in the approved mix design.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to meet the requirements of the specification for the type(s) identified in the contract documents. No action will be taken.
2. The properties are shown to be outside the requirements of the specification for the type(s) identified in the contract documents.
  - a. If the results are within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the material may remain in-place contingent upon an agreed credit. If a credit cannot be agreed upon, the scenario reverts to 2.b.
  - b. If the results are not within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the entire lift (and all overlying lifts) of material will be removed and replaced at the Contractor's expense.

## **204-4 METHOD OF MEASUREMENT.**

**204-4.01. Controlled Low Strength Material.** CLSM will be measured for payment in cubic yards measured to the nearest 0.1 cubic yard computed from the payment lines shown on the contract documents.

A deduction will be made for pipes (based on nominal diameters) and other features when the combined cross-sectional area exceeds 1 ft<sup>2</sup>.

No additional quantity shall be measured for payment to make up losses due to foundation settlement, compaction, erosion or any other cause.

Cross sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown on the contract documents or Standard Sheets, and cannot be reasonably established by the Engineer.

**204-4.02. Lightweight Concrete Fill.** Lightweight Concrete Fill will be measured for payment in cubic yards measured to the nearest 0.1 cubic yard computed from the payment lines shown on the contract documents.

**204-5 BASIS OF PAYMENT.**

**204-5.01 Controlled Low Strength Material.** The unit price bid shall include the costs of all labor, material, and equipment necessary to satisfactorily complete the work.

**204-5.02. Lightweight Concrete Fill.** The unit bid price shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
204.01	Controlled Low Strength Material (CLSM)	Cubic Yard
204.02	Controlled Low Strength Material (CLSM) (No Fly Ash)	Cubic Yard
204.03	Lightweight Concrete Fill (Type A)	Cubic Yard
204.04	Lightweight Concrete Fill (Type B)	Cubic Yard

**SECTION 205 - CONTAMINATED SOIL**

(Last Revised January 2019)

**205-1 DESCRIPTION.**

**205-1.01 General.** Soil contamination may include:

- Petroleum products, which may include, but are not limited to: gasoline, heating oils, diesel fuel, kerosene, jet fuel, lubricating oils, motor oils, greases, and other fractions of crude oil;
- Contaminants associated with past Manufactured Coal Gas Plant (MGP) operations;
- Other contamination by organic constituents including volatile organic compounds;
- Metal(s) such as lead, chromium, and/or other heavy metals; and/or
- Any other constituents that require specialty disposal of the soil.

Additional information regarding contaminated soil may be available in a Special Note entitled *Soil Characterization Information* and/or in a *Contaminated Materials Assessment Report*, if such Special Note and/or Report were prepared by the Department during project design.

**205-1.02 Segregation and Storage.** This work shall consist of segregating contaminated soil from non-contaminated soil during excavation, and the temporary storage and management of contaminated soil (pending sampling, analysis and ultimate disposition) in accordance with an accepted Contaminated Material Handling Plan.

**205-1.03 Field Organic Vapor Monitoring.** This work shall consist of screening soil for contamination during excavation using field vapor monitoring equipment and observations. This work shall be performed by an independent firm hired by the Contractor and completed in accordance with an accepted Field Organic Vapor Monitoring Plan.

**205-1.04 Sampling and Analysis.** This work shall consist of collecting soil samples and arranging for samples to be analyzed at a laboratory in accordance with an accepted Sampling Plan. The laboratory

shall be accredited for the specified parameters by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Approval Program (ELAP). The results of the laboratory analysis will determine or confirm the final regulatory classification of the soil for appropriate handling, transportation, treatment and disposal methods and requirements.

**205-1.05 Transportation and Disposal.** This work shall consist of transporting and disposing of contaminated soil, and completing any other related activities, in accordance with an accepted Disposal Plan. For shipping and disposal purposes, the regulatory classification of the soil (as either contaminated non-hazardous industrial waste or RCRA regulated hazardous waste) will be based on investigations conducted prior to award or based on the results of laboratory analysis included in this section.

**205-1.06 Reuse of Contaminated Soil.** This work shall consist of the reuse of contaminated soil within the contract limits as embankment, fill or other appropriate on-site use. Contaminated soil areas and reuse locations, if provided, are indicated in the contract documents or shall be determined and approved by the Department. The reuse of contaminated soil may be deemed appropriate based upon the following a) an investigation conducted prior to the contract award and/or sampling and analysis conducted during project construction and the qualification of the soil placement as a generic beneficial use determination (BUD) or b) as a site specific BUD obtained from the NYSDEC. The material must be considered suitable material as per Section 203.

## **205-2 MATERIALS.**

**205-2.01 General.** As per the Contaminated Material Handling Plan, (Section 205-1.02).

**205-2.02 Segregation and Storage.** None Specified.

**205-2.03 Field Organic Vapor Monitoring.** Field organic vapor monitoring shall be conducted using a photoionization detector (PID) with a 10.2eV or higher ultraviolet lamp. The PID shall have a minimum detection range of 0.1 ppm to 2,000 ppm and shall be calibrated with isobutylene or other appropriate calibration gas.

A flame ionization detector (FID) may be used in lieu of a PID if a written request and justification is submitted by the Contractor and approved by the Department. The FID shall have a minimum detection range of 1.0 ppm to 50,000 ppm and shall be calibrated with appropriate calibration gas.

**205-2.04 Sampling and Analysis.** None Specified.

**205-2.05 Transportation and Disposal.** None Specified.

**205-2.06 Reuse of Contaminated Soil.** None Specified.

## **205-3 CONSTRUCTION DETAILS.**

**205-3.01 General.** Work activities shall be performed in accordance with the contract documents and with applicable Contaminated Material Handling Plan, Field Organic Vapor Monitoring Plan, Sampling Plan and/or Disposal Plan. The Contractor shall initiate any measures necessary to protect the safety and health of workers and the general public based on the potential hazards associated with the contaminated soil.

**A. Regulatory Compliance.** The Contractor shall conduct all tasks in accordance with all applicable Federal, State, County, and local regulations including, but not necessarily limited to:

- 29 CFR 1910.120 and 29 CFR 1926.65 - Hazardous Waste Operations and Emergency Response;
- 6 NYCRR 360 - Solid Waste Management Facilities;

- 6 NYCRR 364 - Waste Transporter Permits;
- 6 NYCRR 371 - Identification and Listing of Hazardous Wastes (Defines Resource Conservation and Recovery Act (RCRA) defined hazardous wastes;
- 6 NYCRR 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (*applicable to soils regulated as hazardous wastes only*);
- 6 NYCRR Part 375 – Environmental Remediation Program;
- 49 CFR 100 to 180 - USDOT Hazardous Materials Transport and Manifest System Requirements (*applicable to soils regulated as hazardous wastes only*);
- CP – 51/Soil Cleanup Guidance (NYSDEC Policy).

**B. Preparation of Plans and Advance Notification Letters.** The Contractor shall be required to prepare one or more of the plans described below. Two (2) copies of each applicable plan shall be submitted to the Engineer for acceptance at least 30 calendar days prior to commencing work in areas identified as potentially contaminated.

Plans and notification letters shall be prepared based on the type(s) of contamination and locations identified in the contract documents. If a different type of contamination is encountered during work, and additional plans and notification letters must be written, the 30 calendar day lead time for submittals may be modified by the Engineer as appropriate.

**1. Contaminated Material Handling Plan (CMHP).** If the segregation and storage item is included in the contract, a CMHP shall be prepared. The CMHP shall describe the procedures to be used to segregate contaminated soil during excavation, soil storage/stockpile procedures, and safety and health issues. The following information shall be included in the CMHP:

- Name and address of the plan preparer;
- Contract name, contract number and description;
- Describe procedures to be used to segregate contaminated soil during excavation;
- Location of intended soil stockpile, trucks, roll-off container and other storage areas;
- Describe how contaminated soil will be moved to soil storage locations;
- Describe how soil storage/stockpile locations will be prepared and managed;
- Describe how potential air quality impacts such creation of dust particulates and vapors will be minimized to protect air quality within, adjacent to or downwind from the project.
- Describe air monitoring procedures to be used during work, define action levels, and explain the response if action levels are exceeded; The protocol and procedures shall consider action levels for both work personnel and also perimeter/community action levels based on the nature of the contamination and activities conducted
- Hazardous substance evaluation - types of chemicals associated with the waste to be generated,
- Hazard assessment - physical and toxic effects associated with the waste to be generated; Personal protective clothing (PPC) and personal protective equipment (PPE) to be used or available on-site;
- Names of key personnel, emergency contacts and phone numbers;
- List the OSHA training each worker has received. At least one worker must have completed supervisor training per 29 CFR 1910.120(E)(4);
- General and site-specific safety rules, with emergency response procedures and directions to the nearest hospital (with map);
- Decontamination procedures for personnel and equipment; and
- Disposal of contaminated PPC and PPE;

**2. Field Organic Vapor Monitoring Plan (FOVMP).** If the field organic vapor monitoring item is included in the contract, a FOVMP shall be prepared. The following information shall be included in the FOVMP:

- Name and address of the plan preparer;
- Name, address, experience and qualifications of the independent firm performing the field organic vapor monitoring.
- Name, address, experience and qualifications of each individual who will conduct the field organic vapor monitoring. Each individual shall be thoroughly trained in sampling protocols, organic vapor monitoring procedures, and equipment calibration procedures.
- Type(s) of organic vapor monitoring equipment to be used – model, manufacturer and details of the PID or FID equipment that will be used to conduct field organic vapor monitoring; and
- Description of the field organic vapor monitoring and calibration procedures to be used.

**3. Sampling Plan.** If a sampling and analysis item is included in the contract, a Sampling Plan must be prepared. The following information shall be included in the Sampling Plan:

- Name and address of the plan preparer;
- Name, address, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory;
- Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements.
- List of all laboratory tests required by the disposal/treatment facility
- Describe the sample collection and handling procedures to be used; and
- Sampling schedule or a description of the sampling frequency to be used to facilitate prompt disposal of stored soil.

If sampling and analysis items are not included in the contract, a separate Sampling Plan is not required, and the Contractor shall perform any soil sampling and analysis required under the disposal item.

**4. Disposal Plan.** If a disposal item(s) is included in the contract, a Disposal Plan shall be prepared. The following information shall be included in the Disposal Plan:

- Name and address of the plan preparer;
- Name of disposal/treatment facility, address, telephone number and contact person;
- Copy of applicable permits and/or licenses held by the disposal/treatment facility;
- EPA Identification Number and/or State Facility Identification Number issued to the disposal/treatment facility;
- Method(s) of disposal/treatment that will be used;
- Signed letter from the disposal/treatment facility stating it is authorized under law to accept the type of waste being generated, their intent to accept the contaminated waste generated by this contract, and a list of the laboratory tests required by the facility;
- Name of waste transporter, address, telephone number and contact person;
- EPA Identification Number and/or State Transporter Identification Number issued to waste transporter; and
- Copies of all waste transporter permits and/or license plate numbers for vehicles that will be used for transport of waste from the site to the intended disposal/treatment facility;

If a sampling and analysis item(s) is not included in the contract, the following information shall be included in the Disposal Plan for any sampling and analysis that will be conducted:

- Name, address, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory.
- Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements.
- List of all laboratory tests required by the disposal/treatment facility;
- Describe the sample collection and handling procedures to be used; and
- Sampling schedule or a description of the sampling frequency to be used to facilitate prompt disposal of stored soil.

**5. Advance Notification Letters (Letters).** At least 10 calendar days prior to commencing work in contaminated areas, the Contractor shall prepare and submit Advance Notification Letters, (Letters) to the Engineer, the appropriate NYSDEC Regional Office (Environmental Remediation, Spill Prevention and Response), and the local fire department. The Letters shall include the dates that work will occur in contaminated areas, work locations, soil storage/stockpile locations, and the name, field office address and phone number of the Engineer. The Contractor shall provide the Engineer with a copy of the Letters sent to the NYSDEC and fire department.

**205-3.02 Segregation and Storage.** The Contractor shall have an accepted CMHP prior to commencing work within potentially contaminated soil areas. Contaminated soil areas are identified in the contract documents. Soil determined to be contaminated (by PID/FID screening or observation) shall be segregated from non-contaminated soil and stored pending sampling, analysis and disposal. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil. The Contractor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. The Department will determine the preliminary regulatory classification of the suspect soil and will determine how the soil is to be managed.

The Contractor shall not store contaminated soil for more than 40 calendar days, with this time limit beginning on the first day soil is placed in a stockpile, truck-bed or roll-off container. If the Engineer approves additional storage time for soil determined to be contaminated non-hazardous industrial waste, the Contractor shall also request approval from NYSDEC for any storage greater than 60 calendar days. If the Engineer approves additional storage time for soil determined to be RCRA regulated hazardous waste, the Contractor shall also obtain approval from NYSDEC for any storage greater than 90 calendar days. Contaminated soil may be placed in stockpiles, trucks or roll-off containers as follows:

**A. Stockpiles.** The Contractor shall prepare and maintain stockpiles as follows:

**1. Preparation of Stockpile Areas.**

- The area shall be graded to provide positive drainage away from intended stockpile locations.
- All stones, roots, debris and other objects that may puncture polyethylene ground protection shall be removed.
- The ground surface where soil will be stockpiled shall be covered with a minimum of 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- Stockpile locations shall be within the right-of-way and accepted by the Engineer prior to use.

**2. Stockpile Protection.**

- At the end of each work day, contaminated soil stockpiles shall be completely covered with a minimum of 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- Stockpile covers shall be weighted or secured by appropriate means to prevent tearing or removal by weather conditions.
- Stockpiles shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.

### 3. *Maintenance.*

- Stockpile covers, site grading, signing and security measures shall be properly maintained for the duration of storage.
- Damaged covers and other protections shall be repaired or replaced by the Contractor within 24 hours after notification. If this work is not satisfactorily completed within 24 hours, no further stockpiling shall be allowed until such work is completed.

**B. Trucks or Roll-off Containers.** The Contractor shall prepare and maintain trucks and roll-off containers as follows:

- The interior of truck-beds and roll-off containers shall be lined with 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- At the end of each work day, trucks and roll-off containers storing soil shall be completely covered with waterproof tarpaulins. Tarpaulins shall be placed over the top of the truck bed or container (rather than over the soil inside) and shall extend over the sides to prevent water accumulation and the evaporation of contaminants.
- Tarpaulins shall be weighted or secured by appropriate means to prevent tearing or removal by climatic conditions.
- Trucks and roll-off containers shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
- Trucks, roll-off containers and tarpaulins shall be properly maintained for the duration of soil storage.
- Damaged tarpaulins and protections shall be repaired or replaced by the Contractor within 24 hours after notification. If this work is not satisfactorily completed within 24 hours, no further soil storage shall be allowed until such work is completed.
- Trucks and roll-off containers storing contaminated soil shall be located as described in CMHP.

**205-3.03 Field Organic Vapor Monitoring.** The Contractor shall hire an independent firm to perform field organic vapor monitoring in accordance with the accepted FOVMP. The individual conducting the monitoring, hereafter referred to as the Field Monitor, shall be experienced and thoroughly trained in sampling protocols, organic vapor monitoring procedures, and equipment calibration procedures. The Field Monitor shall screen potentially contaminated soil during excavation using field vapor monitoring equipment (PID/FID) and visual observations. Based on the screening results, the Field Monitor shall direct the Contractor on the proper segregation of the material.

Field organic vapor monitoring shall be conducted when working in the contaminated soil areas identified in the contract documents, or whenever unusual or suspicious soil conditions based on visual or odor evidence are encountered during excavation. The Contractor or Field Monitor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. (For health and safety reasons, personnel shall not evaluate odor by placing soil directly to the nose or by inhaling vapors from grab or bag samples).



The Field Monitor shall calibrate the PID/FID on a daily basis prior to starting field work and shall determine a background measurement. Excavated soil shall be tested with the PID/FID at intervals that will ensure the soil is being properly assessed for contamination. The PID/FID will be used to take head space readings from bag samples with the soil temperature at least 50°F. The Field Monitor shall maintain detailed and legible field notes indicating work locations, nature of work being performed, PID/FID head space readings, time of readings, pertinent measurements, visual and odor observations, quantities of both contaminated and non-contaminated soils excavated at each location, storage/stockpile locations, work hours, weather conditions, and any unusual conditions encountered. The Contractor shall provide the Engineer with a copy of all field notes within 5 work days from their recording.

The segregation threshold established below (25ppm) is based on gasoline being the predominant contaminant. If a different contaminant(s) is present or suspected, a different segregation threshold may need to be established. Alternative segregation thresholds may be designated in the contract documents.

PID/FIDs detect and measure gas concentrations (specifically volatile organic compounds); they do not quantify or identify the contaminants in the soil. Therefore, PID/FID readings can not determine specific contaminant concentrations within the soil.

Segregate soil as follows:

**A. Non-Contaminated Soil.** Soil with PID/FID head space readings less than 25 ppm and exhibiting no other evidence of contamination (visual or olfactory evidence) shall be considered non-contaminated. Unless further analysis is performed for confirmation of the non-contaminated soil, this soil will be considered uncontaminated.

**B. Contaminated Soil.** Soil with PID/FID head space readings equal to or greater than 25 ppm and/or soil exhibiting other evidence of contamination (visual or olfactory evidence) shall be considered contaminated. This soil shall be segregated from non-contaminated soil and placed in stockpiles or containers. If sampling and analysis provisions are included for the segregated soil, the results of laboratory analysis will be used to determine its regulatory classification. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil.

**205-3.04 Sampling and Analysis.** The Contractor shall have an accepted Sampling Plan prior to commencing work within potentially contaminated areas. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) and/or grab sample(s) as required for the specific analyses to be completed. Representative samples shall be collected from stored soil as soon as possible after excavation. Soil shall be taken from a depth greater than one foot within the stockpile. Each composite sample shall include a minimum of four sample points. Grab samples shall be collected in a manner so as to best characterize the extent of contamination of the soil in question and best characterize the extent of contamination of the pile. If any soil areas are present with field indications of contamination discretely different than the other areas (i.e., significantly elevated PID/FID readings, staining, etc.), the area may require a separate sample and the Engineer shall be alerted to approve additional sample and analysis. Analyses shall be completed at a NYSDOH ELAP accredited laboratory that is certified to perform the required tests. Analyses shall be completed within 10 work days of sample collection. The Contractor shall provide the Engineer with a copy of all reports within 2 work days of their receipt from the laboratory.

Soil shall not be added to any stockpile, truck or roll-off container after its contents have been sampled. If soil is added after sampling, or sampled soil is otherwise tampered with, the Contractor shall re-sample the soil at no additional cost to the State.

Conduct specified analyses as follows:

**A. Petroleum Contamination Parameter Analysis.** Samples shall be analyzed for petroleum contamination constituents (total constituent analysis) in accordance with CP – 51/Soil Cleanup Guidance, Gasoline and Fuel oil, Tables 2 and 3 using USEPA Method 8260 for volatile organics and methyl t-butyl ether (MTBE) and USEPA Method 8270 for base/neutrals.

**B. Hazardous Waste RCRA Toxicity Characteristic Analysis.** Samples shall be analyzed for Hazardous Waste RCRA Toxicity Characteristics Leaching Procedure (TCLP) constituents. Analysis shall be for full TCLP constituents on the sample extract as prepared by USEPA Method 1311.

**C. Ignitability of Solids Analysis.** Samples shall be analyzed for ignitability by USEPA Method 1030.

**D. pH of Soil and Waste.** Samples shall be analyzed for pH measurement by USEPA Method 9045.

**E. Polychlorinated Biphenyls (PCB) Analysis.** Samples shall be analyzed for PCBs by USEPA Method 8082.

**F. Total Petroleum Hydrocarbons (TPH) Analysis.** Samples shall be analyzed for petroleum hydrocarbons, USEPA Method 8015, gasoline range organics (GROs) and/or diesel range organics (DROs).

**205-3.05 Transportation and Disposal.** The Contractor shall have an accepted Disposal Plan prior to the transportation and disposal of contaminated soil. Contaminated soil shall not be transported until all sampling and analysis, as required by the Department or by the Disposal facility, have been performed and laboratory reports have been provided and accepted by the Department.

**A. Transportation Off Site.**

1. For the duration of transportation, roll-off containers and truck beds shall be completely covered with secured waterproof tarpaulins to prevent water infiltration, evaporation of contaminants and spillage of contaminated soil.
2. The Contractor shall take immediate action to remedy any situation involving a release of contaminated soil during loading or while in transit.
3. Contaminated soil shall not be combined with material from any other source.
4. Contaminated soil shall be transported in vehicles with valid Waste Transporter permits for New York State (and other required permits/licenses from any other states as applicable). The Contractor shall provide a copy to the Engineer of the waste transporter permit documenting that the transporter is authorized to transport waste to the intended disposal/treatment facility. The Contractor shall complete any required shipping papers, labeling, placarding, and weighing/load measurements and shall provide copies of required documentation to the Engineer.
5. Contaminated soil that is determined to be a regulated hazardous waste per the criteria of 6 NYCRR Part 371 shall be shipped with a hazardous waste manifest to a treatment/disposal facility permitted to accept the waste. The Contractor shall complete all required manifests, labeling, placarding, land disposal restriction notifications, and other requirements for shipping and tracking hazardous wastes and shall provide copies of required documentation to the Engineer. The Engineer will provide the Contractor with the EPA Identification Number(s) issued to the Department as the hazardous waste generator and will sign the generator certification statements.

**B. Disposal/Treatment.** Contaminated soil shall be disposed of by the methods and procedures described in the accepted Disposal Plan. Soil characterization information, field identification and confirmation laboratory analyses, if included in the contract, will be used to determine appropriate

classification and category of soil for disposal. Each category of surplus or waste soil shall be handled and disposed of based upon its characterization in accordance with the requirements outlined in §107-10 *Managing Surplus Material and Waste* for the following categories:

- Uncontaminated Soil;
- Contaminated Non-hazardous Industrial Waste; or
- Hazardous Waste regulated by 6 NYCRR Part 371

Soils characterized as contaminated as Hazardous Waste or as Non-hazardous Industrial Waste shall be disposed of and paid for per the items 205.0501 and 205.0502 respectively.

Contaminated soil shall be transported to a disposal/treatment facility within 40 calendar days from the start of storage. The Contractor shall complete under this item any soil sampling and analysis required by the disposal/treatment facility that is not specifically included in the contract.

**C. Documentation.** The Contractor shall provide the Engineer with copies of all receipts from the disposal/treatment facility which indicate the actual quantity of waste received within 2 work days of receipt from the facility. For soil determined to be RCRA regulated hazardous waste, the Contractor shall also provide the Engineer with the appropriate copies of each signed manifest within 2 work days of receipt. Any manifest discrepancies, including the need for exception reporting, shall be reported immediately to the Engineer and shall be resolved by the Contractor.

**205-3.06 Reuse of Contaminated Soil.** The Contractor shall place contaminated soil as embankment, fill or other appropriate on-site use as determined and approved by the Department, and in accordance with the contract documents. Only appropriate soils placed in appropriate locations as included in the contract documents shall be reused.

#### **205-4 METHOD OF MEASUREMENT.**

**205-4.01 General.** (Vacant)

**205-4.02 Segregation and Storage.** The work under segregation and storage will be measured for payment on a lump sum basis.

**205-4.03 Field Organic Vapor Monitoring.** The quantity for payment will be in hours of field organic vapor monitoring performed, measured to the nearest one-half hour.

**205-4.04 Sampling and Analysis.** The quantity to be measured for payment will be the number of soil samples analyzed as included in the contract documents.

**205-4.05 Transportation and Disposal.** The quantity to be measured for payment will be in tons of contaminated soil transported to a disposal/treatment facility, measured to the nearest 0.1 ton. If measurement of the contaminated soil by weight is not feasible, a conversion factor of 1.4 tons per cubic yard will be used to determine the quantity for payment.

**205-4.06 Reuse of Contaminated Soil.** The quantity to be measured for payment will be in cubic yards of contaminated soil stockpiled for reuse, computed to the nearest whole cubic yard.

**205-5 BASIS OF PAYMENT.** The price bid shall include the cost of all labor, materials and equipment necessary to complete the work. Excavation will be paid for separately.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
205.02nn	Segregation and Storage of Contaminated Soil	Lump Sum

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205.03	Field Organic Vapor Monitoring of Contaminated Soil	Hour
205.0401	Petroleum Contamination Parameter Analysis	Each
205.0402	Laboratory Analysis for Hazardous Waste RCRA Toxicity Characteristic	Each
205.0403	Laboratory Analysis for Ignitability	Each
205.0404	Laboratory Analysis for ph	Each
205.0405	Laboratory Analysis for Polychlorinated Biphenyls (PCB's)	Each
205.0406	Laboratory Analysis for Total Petroleum Hydrocarbons– Gasoline Range Organics	Each
205.0407	Laboratory Analysis for Total Petroleum Hydrocarbons– Diesel Range Organics	Each
205.0501nn	Disposal of Contaminated Hazardous Waste Soil	Ton
205.0502nn	Disposal of Contaminated Non-Hazardous Waste Soil	Ton
205.06nn	Reuse of Contaminated Soil	Cubic Yard

Note: nn denotes serialized pay item for each discrete contaminated area of property as indicated on the plans. The serialized items allow for different plans and different disposal procedures for discretely different areas and nature of the contamination.

## SECTION 206 - TRENCH, CULVERT AND STRUCTURE EXCAVATION

### 206-1 DESCRIPTION

**206-1.01 General.** This work shall consist of the excavation and disposal of excavated material required for trenches, culverts, structures, conduit and direct burial cable not otherwise provided for in other sections of these specifications. All such excavation shall be unclassified excavation as defined in §203-1.01. The work shall be conducted in accordance with 29 CFR 1926 Subpart P.

**206-1.02 Structure Excavation.** The work specified under this item shall include the excavation for all bridge foundations, walls and other major structures.

**206-1.03 Trench and Culvert Excavation.** The work specified under this item shall include the excavation of all materials and disposal of excavated material required for trenches, culverts, pipes, manholes, drainage structures and other minor structures, conduit and direct burial cable.

**206-1.04 Conduit Excavation and Backfill including Surface Restoration.** The work specified under this item shall include the excavation, necessary backfill and surface restoration required for conduits and direct burial cables.

**206-1.05 Test Pits.** The work specified under this item shall include the excavation and backfill of test pits at locations shown in the contract documents, or as directed by the Engineer. Excavation and backfill methods, limits and equipment used shall be approved by the Engineer. This work will not relieve the contractor of the responsibility to locate underground facilities as required under 16 NYCRR 753.

**206-2 MATERIALS.** (Not Specified).

### 206-3 CONSTRUCTION DETAILS

**206-3.01 General.** The appropriate construction details specified for “Excavation and Embankment” in §203-3.01 through §203-3.14 shall apply to the work specified in this section.

The excavation shall be dewatered and kept free from water, snow and ice when necessary.

Special care shall be taken not to disturb the bottom of the excavation, and not to remove the material at final grade until just before the structure is placed.

The provisions of §203-3.01D *Suitable Materials* and/or §203-3.01E *Unsuitable Materials* shall apply to all material excavated under this section.

The Contractor shall carry out all excavation operations in a safe and prudent manner so that the workers, the public, and adjacent public and private property will be protected from unreasonable hazard in accordance with §107-05K. *Open Excavations and Trenches*.

Slopes may not be steeper than allowed by 29 CFR 1926 Subpart P.

When excavation is required for the installation of conduit or direct burial cable, the Contractor shall notify the Engineer upon completion of the excavation. No conduit or cable shall be placed in the excavation until the Engineer has approved the depth and cross-section.

When the Contractor, in placing conduits, direct burial cable or utilities, excavates into the pavement, subgrade, subbase, or shoulder courses, such courses must be replaced in kind, character and condition, to maintain a uniform road section, except when the Contract Documents specify that other materials shall be used.

**206-3.02 Structure Excavation.** The Contractor's competent person shall verify field conditions, including excavation depth, groundwater, and soil conditions with the Engineer in accordance with 29 CFR 1926 Subpart P prior to performing structure excavation for all bridge foundations, walls and other major structures.

**206-3.03 Trench and Culvert Excavation.** The Contractor's competent person shall verify field conditions, including excavation depth, groundwater, and soil conditions with the Engineer in accordance with 29 CFR 1926 Subpart P prior to performing trench and culvert excavation.

For utility lines, exclusive of conduit and cable lines, of less than 12 inches in diameter, the excavation width shall be the actual bottom width necessary to properly perform the installation work required, or 3 feet, whichever is less.

**206-3.04 Conduit Excavation and Backfill including Surface Restoration.** When the Contractor is required to excavate through portland cement concrete, asphalt concrete, composite pavement, or sidewalk, a saw cut shall be made along neat lines and to the depth as shown in the contract documents or as directed by the Engineer.

Any damage to existing pavement, sidewalk, curb or other facilities caused by the Contractor's operations under this item shall be repaired by the Contractor at no additional cost to the State.

**206-3.05 Test Pits.** The Contractor shall excavate and backfill test pits in order to determine existing underground utility type, size and/or condition where new utility connections to existing facilities are proposed. The Contractor shall excavate and backfill test pits in a manner approved by the Engineer that prevents damage to wrappings, coatings or other protective coverings, such as by hand digging, vacuum excavation or similar non-destructive locating equipment. The limits of the excavation shall be those sufficient to determine existing utility type, size and/or condition.

## **206-4 METHOD OF MEASUREMENT**

**206-4.01 General.** The quantity of excavation will be in cubic yards, to the nearest whole cubic yard, computed from payment lines shown on the plans or the appropriate standard sheets. Work performed beyond any designated payment line will not be included in the computation of quantities for the item involved.

**206-4.02 Structure Excavation.** Vacant.

**206-4.03 Trench and Culvert Excavation.** Unless otherwise shown or indicated on the contract plans, payment lines for excavation of pipe and culvert lines, and minor structures will be determined as follows:

**A. Bottom Payment Line.** The elevation of the bottom payment line will be the invert elevation of the pipe, conduit, or culvert. For pipes, conduits, or culverts of nominal horizontal dimensions of 12 to 144 inches, the width of the excavations at the bottom payment line will be the nominal inside horizontal dimension of the pipe, conduit, or culvert plus 4 feet, or three (3) times the nominal inside horizontal dimension, whichever is less; for pipes with a nominal horizontal dimension greater than 144 inches the width will be as shown on the appropriate standard sheets or in the contract documents. For concrete and smooth interior corrugated polyethylene pipe, twice the minimum wall thickness will be added to the preceding. For concrete pipe, the bottom payment line is the Bedding Control Line shown on the applicable standard sheet.

**B. Top Payment Line.** The top payment line will be the surface at the centerline of the pipe, culvert or conduit immediately prior to commencing trench excavation.

**C. Side Payment Lines.** The side payment lines of the excavation will be vertical to the bottom payment line.

For utility lines, exclusive of conduit and cable lines, of less than 12-inch diameter, the excavation width will be the actual bottom width necessary, as determined by the Engineer, to properly perform the installation work required, or 3 feet, whichever is less.

**D. Payment Lines for Minor Structures.** Payment lines for minor structures will be vertical from the bottom of the footing and will extend vertically from a line 2 feet from the perimeter of the structure footing. The top payment line shall be the same as for (B) above. The bottom payment line will be the bottom of footing elevation, or the bottom of undercut elevation as directed by the Engineer.

**206-4.04 Conduit Excavation and Backfill including Surface Restoration.** The quantity of conduit and/or cable excavation and backfill including surface restoration for payment will be the number of linear feet measured along the center of the conduit and/or cable placed, in accordance with the methods stated below.

Wherever a pair or group of conduits and/or cables are physically connected together, they will be considered as a single conduit and/or cable.

A. Wherever conduit and/or cable in the same trench are physically separated laterally by 6 inches or more between centerlines, as shown on the plans or as directed by the Engineer, the linear feet measurement will be made along the center of each conduit and/or cable.

B. Wherever a pair or group of conduits and/or cable in the same trench are physically separated laterally by less than 6 inches between centerlines of adjacent conduit and/or cable, as shown on the plans or as directed by the Engineer, the linear feet measurement for those conduits and/or cable will be made along the center of that pair or group of conduit and/or cables.

**206-4.05 Test Pits.** The quantity to be measured for payment will be the number of test holes excavated and backfilled in accordance with the contract documents.

## **206-5 BASIS OF PAYMENT**

**206-5.01 General.** The cost for necessary guarding to protect the public from open trenches, and that required for the protection to ensure the safety of the workers, and for any necessary excavation support

shall be included in other items.

No extra payment will be made for the cost of any materials excavated or placed outside the payment lines shown on the plans or as described in this specification. No extra payment will be made for excavation protection or support systems not shown in the contract plans, unless use of such systems is directed by the Engineer.

With exception of the Conduit Excavation and Backfill including Surface Restoration item, the work of replacing pavement, subcourses and shoulder courses will be paid for and performed under the provisions of their respective items and subsections.

**206-5.02 Structure Excavation.** The unit price bid for this work shall include the cost of labor, materials and equipment required to satisfactorily complete the work including the costs of excavation, disposal of excavated material, presplitting rock excavations where required, and keeping the site dewatered and free from earth, water, ice and snow where necessary. Payment for Sheeting, Cofferdams or Temporary Water Diversion Structures required by the contract documents will be made in accordance with the appropriate item.

Where cofferdams are specified for structure excavation, the work required to keep the site free from earth, water, ice and snow shall be included in the item for cofferdams when necessary.

**206-5.03 Trench and Culvert Excavation.** The unit price bid for this work shall include the cost of labor, materials and equipment required to satisfactorily complete the work, including the costs of excavation, disposal of excavated material, presplitting rock excavations where required, and keeping the site dewatered and free from earth, water, ice and snow when necessary.

**206-5.04 Conduit Excavation and Backfill including Surface Restoration.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily excavate and backfill the trench, including sawcutting, and to restore and replace any pavement, shoulder, and sidewalk courses, subcourses, curbs, drives, lawns and other top surfaces as required to complete the work.

**206-5.05 Test Pits.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily excavate and backfill the test pit and replace any pavement, shoulder and sidewalk courses, subcourses, curbs, drives, lawns and other top surfaces required to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
206.01	Structure Excavation	Cubic Yard
206.0201	Trench and Culvert Excavation	Cubic Yard
206.03	Conduit Excavation and Backfill including Surface Restoration	Foot
206.05	Test Pit Excavation	Each

## **SECTION 207 - GEOSYNTHETICS**

### **207-1 DESCRIPTION**

**207-1.01 Geotextiles.** The work shall consist of furnishing and installing approved Geotextile of the Class and Type indicated, at the locations, and in the manner shown on the plans or as directed by the Engineer, in writing, prior to performing the work.

**207-1.02 Geomembranes.** The work shall consist of furnishing and installing approved Geomembrane, including the preparation of the surface upon which the Geomembrane is placed, at the locations and in the manner shown on the plans or as directed by the Engineer, in writing, prior to performing the work.

**207-1.03 Prefabricated Composite Drains for Structures.** The work shall consist of furnishing and installing an approved Prefabricated Composite Structural Drain (PCSD) or Prefabricated Composite Integral Abutment Drain (PCIAD) as specified at the location (s) shown on the contract documents or as directed by the Engineer, in writing, prior to performing the work.

Prior to installation, the Contractor shall furnish the Engineer with copies of the manufacturer's literature with details and installation requirements for the PCSD or PCIAD. If not included in the manufacturer's literature, a letter identifying the geotextile wrap shall also be provided to the Engineer.

**207-2 MATERIALS.** Materials shall meet the requirements specified in the following subsections of Section 700 – Materials.

Geotextiles	§737-01
Geotextile Bedding	§737-01 A.
Geotextile Separation	§737-01 B.
Geotextile Drainage	§737-01 C.
Geotextile Slope Protection	§737-01 D.
Geotextile Stabilization	§737-01 E.
Turbidity Curtain	§737-01 F.
Silt Fence	§737-01 G.
Geomembranes	§737-02
Prefabricated Composite Structural Drains	§737-04
Prefabricated Composite Integral Abutment Drains	§737-05

Materials shall be subject to the Department's Quality Assurance (QA) program outlined in Section 737.

Adhesives used for joining geotextiles shall be fast-tacking, not be detrimental to the performance, lifespan or function of the geotextile, and create a bond strong enough to meet AASHTO M288 requirements for seam efficiency.

### **207-3 CONSTRUCTION DETAILS**

#### **207-3.01 Geotextiles**

**A. General.** The Geotextiles shall be protected from exposure to sunlight during transport and storage. After placement, the Geotextile shall not be left uncovered for more than two (2) weeks.

Traffic or construction equipment will not be permitted directly on the Geotextile. Geotextiles may be joined by sewing, using adhesive or overlapping. Sewn seams shall be lapped a minimum of 4 in. and double sewn. The thread used to sew the seam shall be nylon or polypropylene. Geotextiles that are joined using adhesive shall be lapped a minimum of 4 in. Overlapped seams shall have a minimum overlap of 20 in. except when placed under water where the overlap shall be a minimum of 3 ft. All seams shall be subject to the approval of the Engineer. Geotextile which becomes torn or damaged due to the Contractor's operations shall be replaced or patched at no cost to the State. The patch shall extend 3 ft. beyond the perimeter of the tear or damage.

**B. Bedding and Slope Protection.** The Geotextile shall be placed and anchored on a prepared surface approved by the Engineer. The Geotextile shall be laid loosely but in intimate contact with the soil so that



placement of the overlying materials will not stretch or tear the Geotextile. Where Geotextile is placed above water, the backfill placement shall begin at the toe and proceed up the slope.

Where Geotextile is placed under water, the long dimension (provided that the width dimension is wider than the channel width) shall be placed parallel to the direction of flow. If the width dimension is not wider than the channel width, the long dimension shall be placed perpendicular to the direction of flow. Successive Geotextile sheets shall be overlapped so that the upstream sheet is placed over the downstream sheet. As the Geotextile is placed under water, the backfill material shall be placed on it to the required thickness. The Geotextile placement shall not progress more than 50 ft. ahead of the backfill placement.

Rip-rap, stone filling (Heavy) or stone filling (Medium) shall not be dropped onto the Geotextile from a height greater than 1 ft. Slope protection and smaller sizes of stone filling shall not be dropped onto the Geotextile from a height exceeding 3 ft.

**C. Separation and Stabilization.** The Geotextile shall be placed as directed by the Engineer. The Geotextile shall be laid loosely but in intimate contact with the soil so that placement of the overlying material will not stretch or tear the Geotextile.

**D. Drainage.** The Geotextile shall be placed to conform loosely to the shape of the trench.

After placing the filter material, the Geotextile shall be folded over the top of the filter material to produce a minimum overlap of 12 in. The Geotextile shall then be covered with the subsequent course.

**207-3.02 Geomembranes.** The Geomembrane shall be protected during transport and storage. The surface upon which the Geomembrane is to be placed shall be within reasonable conformity to the proposed grade. Traffic or construction equipment will not be permitted directly on the Geomembrane. Care shall be exercised by workers when walking or working on the Geomembrane.

Seams shall be sealed as per the manufacturer's recommendations and to the satisfaction of the Engineer. The edges of the Geomembrane shall be secured in the manner shown on the contract plans or as directed by the Engineer.

Geomembrane which becomes torn or damaged shall be replaced or patched as ordered by the Engineer. The patch shall extend 3 ft. beyond the perimeter of the tear or damage and the seams shall be approved by the Engineer.

**207-3.03 Prefabricated Composite Drains for Structures.** The Contractor shall install the drain in conformance with the manufacturer's installation procedures. The drain shall be installed so that the backfill, when placed, will be in contact with the geotextile and forms a continuous drainage layer without interruption within the drain's plane. In installations where concrete is to be poured against the prefabricated composite drain, only drains with impermeable cores will be allowed. At all locations, a positive outlet for the water in the drain shall be provided. This may involve making a hole in the core at the weep hole locations for approved drains with an impermeable core. Do not puncture the geotextile. Any damaged geotextile shall be repaired.

Adhesive shall be applied to the wall surface, and not directly to the drain.

During all periods of shipment and storage, the drain shall be wrapped and protected from direct exposure to sunlight, mud, dirt and debris.

Care shall be exercised while backfilling to prevent damage to the drain. Repairs or replacements of drain damaged by construction operations shall be performed, as directed by the Engineer, at no cost to the State.

## **207-4 METHOD OF MEASUREMENT**

### **207-4.01 Geotextiles**

**A. General.** The quantity of Geotextile will be the number of square yards computed from the payment lines indicated in the contract documents. Measurement will not be made for Geotextile used for repairs, seams, or overlaps. If taken, the amount of quality assurance samples will be added to this quantity.

**B. Drainage.** The quantity of Geotextile will be measured in area based on the theoretical perimeter determined from the typical section indicated in the contract documents.

**207-4.02 Geomembranes.** The quantity of Geomembrane will be the number of square yards computed from the payment lines indicated in the contract documents. Measurement will not be made for Geomembranes used for repairs, seams, or overlaps.

**207-4.03 Prefabricated Composite Drains for Structures.** The quantity of PCSD or PCIAD will be measured in square yards installed computed from the payment lines indicated in the contract documents.

## **207-5 BASIS OF PAYMENT**

**207-5.01 Geotextiles.** The unit price bid shall include the cost of furnishing all labor, equipment, and materials necessary to complete the work, including the cost of preparing the surface upon which the Geotextile is placed. No payment will be made for replacement or repairs.

**207-5.02 Geomembranes.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including the cost of preparing the surface upon which the Geomembrane is placed and securing the edges of the Geomembrane. No payment will be made for replacement or repairs.

**207-5.03 Prefabricated Composite Drains for Structures.** The unit price bid shall include the cost of furnishing all labor, equipment, and material necessary to complete the work. No payment will be made for repairs or replacement.

### ***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
207.20	Geotextile Bedding	Square Yard
207.21	Geotextile Separation	Square Yard
207.22	Geotextile Drainage	Square Yard
207.23	Geotextile Slope Protection	Square Yard
207.24	Geotextile Stabilization	Square Yard
207.25	Geomembrane	Square Yard
207.26	Prefabricated Composite Structural Drain	Square Yard
207.27	Prefabricated Composite Integral Abutment Drain	Square Yard

## **SECTION 208 - STORMWATER MANAGEMENT PRACTICES**

**(Last Revised May 2022)**

**208-1 DESCRIPTION.** The work shall include furnishing, installing, maintaining, and cleaning stormwater management practices, in accordance with the contract documents and as directed by the Engineer.

### **208-1.01 General**

#### ***A. Definitions.***

**1. Stormwater Management Practices (SMP).** SMPs include structural, soil and vegetative practices that are acceptable for water quality treatment and water quantity control and meet stormwater management performance criteria described in the *New York State Stormwater Management Design Manual* (issued by the New York State Department of Environmental Conservation).

**2. Stormwater Treatment Device (SWTD).** A SWTD is a commercially available Stormwater Management product that uses hydrodynamic action, velocity reduction, sediment settling and/or filtering to separate suspended solids from stormwater. SWTDs are installed as part of a stormwater treatment system consisting of one or more SWTDs and all required pipes, such as connection, inlet, bypass and outlet. SWTDs are used alone or in a series with other SMPs.

**3. Water Quality Treatment.** SMPs are implemented to improve water quality by capturing and treating runoff to remove pollutants from small, frequent storm events that tend to contain higher pollutant levels.

**4. Water Quantity Control.** SMPs are designed to attenuate or reduce peak flows from storm events to the pre-developed levels to prevent channel erosion, maintain pre-developed hydrology and hydraulics, and often also provide groundwater recharge.

**5. Maintenance.** Maintenance shall include inspection, repair, and upkeep of stormwater management practices.

**6. Cleaning.** Cleaning shall include inspection, removal and disposal of trash, debris, hydrocarbons, nutrients and/or metals collected by the practice.

**208-1.02 SWTD.** The work shall include furnishing, installing, and maintaining a SWTD, in accordance with the contract documents and as directed by the Engineer.

**208-1.03 Cleaning SWTD.** The work shall include cleaning SWTDs in accordance with the contract documents and as directed by the Engineer.

## **208-2 MATERIALS.**

**208-2.01 General.** None specified

**208-2.02 SWTD.** The materials shall meet the requirements of the following subsections of Section 700, *Materials and Manufacturing*.

Stormwater Treatment Device

738-01

The Contractor shall provide a SWTD that is:

- Sized for the maximum water quality flow shown in the contract documents
- Appears on the Approved List for the corresponding payment item

Pipe (inlet, outlet, bypass and connection) sizes and locations for single unit or multiple units shall be as indicated in the contract documents and paid for under separate payment items.

Backfill shall be in conformance with §733-11, *Select Granular Fill* and shall be paid for separately.

**208-2.03 Cleaning SWTD.** None specified.

### **208-3 CONSTRUCTION DETAILS.**

**208-3.01 General.** The Contractor shall inspect and maintain the stormwater management practices for the duration of the contract. The schedule for inspecting and maintaining each stormwater management practice shall be per the manufacturer's recommendations to sustain practice performance and efficiency, and/or as indicated in the contract documents. Inspection and maintenance shall be included in the cost of the payment item.

The Contractor shall keep a record of stormwater management practice inspections and maintenance. Stormwater management practices not performing to manufacturer's defined efficiency standards shall be repaired or replaced at no additional cost to the State.

**208-3.02 SWTD.** The Contractor shall install and maintain the SWTD in accordance with manufacturer recommendations and the contract documents.

**A. Excavation.** Excavation shall be in conformance with §206-3.01 and §206-3.02, *Trench, Culvert, and Structure Excavation* and will be paid for separately. No structure shall be backfilled until all mortar has completely set.

**B. Backfill.** Backfill shall be installed per §203-3.06, *Select Granular Fill* and will be paid for separately.

**C. Submittals.** A minimum of two weeks prior to installation, the Contractor shall provide a copy of the manufacturer's cut sheets, installation details, and operations and maintenance manuals for each SWTD unit type. Electronic copies are acceptable.

**D. Basis of Acceptance.** Acceptance criteria for SWTD:

- The SWTD manufacturer's name appears on the Department's Approved List.
  - The SWTD has been installed per manufacturer's instructions and at the locations indicated in the contract documents.
  - The SWTD has received maintenance – as needed – during the life of the contract and per manufacturer's recommendations.
  - The SWTD's mechanical features are functioning – as described in the manufacturer's operations and maintenance manual – at the completion of the contract.
- Acceptance criteria for cleaning:
- The SWTD has been cleaned per §208-3.03 by the Contractor during the life of the contract as needed, and immediately prior to final contract acceptance.

**208-3.03 Cleaning SWTD.** Cleaning shall be performed during dry weather. Entry into the SWTD or nearby drainage structure may be necessary to complete the work described under this specification. SWTDs and other subsurface stormwater drainage devices are confined spaces. Entry into confined spaces requires compliance with OSHA safety procedures (29 CFR 1910.146 and 29 CFR 1926.21) and NYS Industrial Code Rules 12 and 23. The Contractor shall ensure that employees wear all required personal protective equipment (PPE) when performing this work.

**A. Advanced Preparation.** At least 15 days prior to commencing SWTD cleaning work, prepare and submit the following information to the Engineer for review and approval:

- Identification of and information on the proposed treatment/disposal facilities to include:
  - name
  - address
  - contact person
- For transportation off-site, the identification of and information on the proposed waste transporter to include:
  - name
  - address
  - telephone number
  - contact person
  - NYSDEC Part 364 Waste Transporter Permit number

**B. Inspection.** In the presence of the Engineer, the Contractor shall open the SWTD access and make a visual inspection. The Contractor shall determine if the device's inlet and/or outlet is submerged. If the inlet/outlet is submerged, the pipe(s) connecting to the SWTD shall be plugged using a standard rubber expandable plug, or other type of approved fabricated plug. The depth of accumulated sediment in each device shall be measured with a probe and recorded.

**C. Cleaning.** All solids (trash, debris, floatables, sludge, sediment, and other) and floating petroleum product (oil) shall be removed from all chambers (sediment chamber and outflow chamber) and pipes. The SWTD shall be cleaned using the following steps:

- Remove any floating petroleum product (oil) with sorbent pads/cloths
- Remove all trash, debris and floatables
- Remove all remaining solids (sludge, sediment, and other) and liquids via a vacuum truck
- Dispose of the liquid and all solids separately as described below
- Remove plugs and reset manholes

**D. Disposal.** The Contractor shall dispose of all resulting waste including oil (sorbent pads/cloths), solids (e.g. trash, debris, floatables, sludge, sediment, and other) and liquids. The solid waste product of the cleaning operation (including sorbent material) is considered a nonhazardous solid waste under NYSDEC Part 360 regulations. Liquid waste taken off-site will be considered petroleum-contaminated liquid under NYSDEC Part 360 regulations and shall be transported, treated and/or disposed of at a permitted waste treatment and/or disposal facility. Any single shipment of liquid waste weighing more than 500 pounds must be transported by a permitted hauler who meets NYSDEC's 6 NYCRR Part 364 industrial waste transport requirements.

**E. Basis of Acceptance.** The Contractor must submit receipts documenting proper handling of the waste materials (including contaminated liquid) during transport and disposal, in accordance with all Federal, State and local regulations.

## **208-4 METHOD OF MEASUREMENT.**

**208-4.01 General.** Vacant.

**208-4.02 SWTD.** The work will be measured as the number of each SWTD installed and maintained.

**208-4.03 Cleaning SWTD.** The work will be measured as the number of each SWTD cleaned.

## **208-5 BASIS OF PAYMENT.**

**208-5.01 General.** Vacant.

**208-5.02 SWTD.** The unit price bid for each SWTD shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including manhole frames and covers, and SWTD cleaning and maintenance.

**A. Excavation.** Excavation will be paid for separately under §206 *Trench and Culvert Excavation*.

**B. Backfill.** Backfill of drainage structures and leaching basins will be paid for under the item(s) shown in the contract documents.

**C. Pipes.** Pipes (outlet, inlet, connection, bypass and others) necessary to complete the stormwater treatment system will be paid for separately.

Progress payments will be made upon the satisfactory installation of the SWTD at 75% of the unit price bid. The remaining percentage will be paid after the SWTD has been cleaned and the Engineer has verified that the SWTD is properly functioning at the completion of the contract.

**208-5.03 Cleaning SWTD.** The unit bid price per each SWTD cleaned shall include the cost of furnishing all labor, materials, equipment, transport and disposal necessary to satisfactorily complete the work.

Progress payments will be made upon the satisfactory cleaning of the SWTD at 75% of the unit price bid. The remaining percentage will be paid after the Engineer has verified and checked quantities on receipts for all wastes received by the disposal facilities.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
208.5101	SWTD - Maximum Treatment Flow Rate up to 1.0 cfs	Each
208.5201	SWTD - Maximum Treatment Flow Rate over 1.0 cfs up to 2.0 cfs	Each
208.5301	SWTD - Maximum Treatment Flow Rate over 2.0 cfs up to 2.8 cfs	Each
208.5401	SWTD - Maximum Treatment Flow Rate over 2.8 cfs up to 3.8 cfs	Each
208.5501	SWTD - Maximum Treatment Flow Rate over 3.8 cfs up to 5.0 cfs	Each
208.5601	SWTD - Maximum Treatment Flow Rate over 5.0 cfs up to 7.0 cfs	Each
208.5701	SWTD - Maximum Treatment Flow Rate over 7.0 cfs up to 10.0 cfs	Each
208.5801	SWTD - Maximum Treatment Flow Rate over 10.0 cfs up to 15.0 cfs	Each
208.5901	SWTD - Maximum Treatment Flow Rate over 15.0 cfs up to 25.0 cfs	Each
208.60	Cleaning Stormwater Treatment Device	Each

## **SECTION 209 - SOIL EROSION AND SEDIMENT CONTROL**

(Last Revised January 2019)

**209-1 DESCRIPTION.** This work shall consist of furnishing, installing, inspecting, maintaining, and removing soil erosion and sediment control measures as shown on the contract documents and as directed by the Engineer.

**209-1.01 Erosion Control.** Erosion Control is any action taken to reduce soil erosion and control sedimentation, including the use of mulch, straw/wood fiber mulch, seed and mulch, seed and straw/wood fiber mulch, rolled erosion control products, soil stabilizers, and pipe slope drains.

**209-1.02 Sediment Control.** Sediment Control is any action taken to minimize suspended solid material transport by water, including the use of sediment traps, turbidity curtains, sediment filter logs, silt fence, check dams, drainage structure inlet protection, and stabilized construction entrance/exits.

**209-2 MATERIALS.**

**209-2.01 General.** None specified.

**209-2.02 Mulch-Temporary.** The materials shall meet the requirements of the following subsections of §700 *Materials and Manufacturing*.

Straw	713-19
Wood Fiber Mulch	713-11

**209-2.03 Seed-Temporary.** The materials shall meet the requirements of the following subsections of §700 *Materials and Manufacturing*.

Seeds	713-04
Water	712-01

Seed shall be ryegrasses (annual or perennial) or cereal grasses suitable for the area as a temporary cover and which will not compete with the grasses sown later for permanent cover.

**209-2.04 Check Dams.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Stone Filling	733-21
Coarse Aggregate	703-02
Sediment Filter Logs	713-20
Geotextile	737-01

**A. Stone Check Dams.** Stone filling shall meet the requirements of §733-21 *Stone Filling, Light* and/or §703-02 *Coarse Aggregate*, size designation 1 or 2 as described in Table 703-04.

Geotextile bedding shall conform to §737-01 *Geotextiles*, Table 737-01A – Bedding Geotextile Requirements.

**B. Gravel Bag Check Dams.**

**1. Bags.** Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 *Geotextile* with a strength class 1 or 2 and shall include ties. No burlap bags shall be allowed.

**2. Gravel.** Coarse aggregate shall meet the gradation requirements of size designation #1 or #2 of Table 703-4 and shall be used as the fill material.

Gravel bags shall be individually tied and double bagged. The bag with fill material shall be inversely inserted into the second bag in order to prevent leakage.

**C. Prefabricated Check Dams.**

**1. Temporary Silt Dike.** Temporary silt dikes shall be triangular in cross section, and have a height of at least 10 inches in the center with two equal sides and a 18 inch to 24 inch base. The inner material shall be urethane foam. The outer cover shall be a woven bedding type geotextile

(§737-01; Table 737-01A) wrapped around the inner triangle and shall extend 24 inches to 36 inches beyond each side of the triangle base.

Wire staples used to secure the prefabricated check dam shall be No. 11 gauge wire and be 6 inches to 8 inches long.

Stone shall meet the requirements of §703-02 *Coarse Aggregate*, size designation 1 as described in Table 703-4. Stone filling shall be placed over the geotextile apron. Refer to the standard sheets for additional information.

**2. Sediment Filter Logs.** The materials for prefabricated sediment filter logs check dams shall meet the requirements of §713-20 *Sediment Filter Logs*.

**209-2.05 Linear Measures.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Geotextiles	737-01
Sediment Filter Logs	713-20

**A. Silt Fence-Temporary.** A silt fence assembly shall consist of silt fence geotextile, posts, and fasteners and may include mesh support consistent with the Approved List.

**1. Geotextile.** Silt fence geotextile shall meet the requirements of §737-01 *Geotextiles*, G. Silt Fence and be listed in the Approved List.

**2. Posts.** Posts shall meet the following requirements:

Wood posts shall have a minimum cross section area of 3.5 square inches; steel post shall be “T” or “U” shaped in cross section, with a minimum weight of 1.33 pounds per foot.

Posts shall be a minimum of 40 inches long and shall be spaced according to the geotextile selected, as indicated in the Approved List.

**3. Mesh Support.** For those silt fence geotextiles on the Approved List that require a mesh support, the support shall consist of 14 gauge (minimum) welded wire mesh with a maximum 6 inch by 6 inch opening or polymeric mesh. All mesh support shall be a minimum of 30 inches in height.

**4. Fasteners.** Fasteners shall be heavy duty staples, hog rings, tie wires, or any other fastener compatible with the post material.

**B. Sediment Filter Logs.** A sediment filter log assembly shall consist of the sediment filter log and posts.

**1. Posts.** Posts shall be nominal 2 x 2 wood. The length of posts shall be at least 16 inches greater than the diameter of the log.

**209-2.06 Sediment Traps-Temporary.** The materials shall meet the requirements of the following subsections of §700 *Materials and Manufacturing*:

Stone Filling	733-21
Geotextile	737-01

**A. Impervious Embankment Material.** Impervious embankment material shall be §733-08 *Embankment in Place*, §733-10 *Select Fill*, §733-11 *Select Granular Fill*, or §733-12 *Select Granular Fill Slope Protection*, and the impervious embankment material shall have the following gradation:



Sieve Size	Percent Passing by Weight
6 inch	90 – 100
3/4 inch	50 – 100
1/4 inch	40 – 90
#40	30 – 85
#200	25 - 75

**B. Gravel Bags.**

**1. Bags.** Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 *Geotextile* with a strength class 1 or 2 and shall include ties. Burlap bags will not be allowed.

**2. Gravel.** Coarse aggregate used as fill material shall meet the gradation requirements of size designation 1 or 2 of Table 703-4.

Each gravel bag shall be individually tied and double bagged. The bag with fill material shall be inversely inserted into the second bag in order to prevent leakage.

**C. Geotextile Bedding.** The geotextile bedding material shall meet the requirements of §737-01 *Geotextile*, Table 737-01A. Bedding Geotextile.

**D. Riser Pipe.** Riser Pipe shall be 16 gauge corrugated steel, aluminum or polyethylene and perforated with 1 inch diameter holes or slits spaced 6 inches vertically by 6 inches horizontally and placed in the concave portion of the corrugations. No holes will be allowed within 6 inches of the outlet pipe.

**E. Hardware Cloth.** Hardware cloth wire shall meet ASTM A740-98 Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric), be 23 gauge (minimum) and have 1/4 inch or 1/2 inch openings.

**F. Geotextile Drainage Fabric.** The geotextile drainage fabric shall meet the requirements of §737-01 *Geotextile*, Table 737-01C Drainage Geotextile Requirements.

**G. Steel Base Plates.** Steel base plates shall be 1/4 inch minimum thickness.

**H. Outlet Pipes.** The outlet pipe shall be 12 inch 16 gauge corrugated steel pipe.

**I. Stone Filling.** Stone filling shall meet the requirements of §733-21 *Stone Filling*.

**209-2.07 Pipe Slope Drain-Temporary.** The materials shall meet the requirements of the following subsections of §700 *Materials and Manufacturing*.

Smooth Interior Corrugated Polyethylene Pipe	706-12
Corrugated Interior Polyethylene Pipe	706-14
Corrugated Steel Pipe	707-02
Corrugated Aluminum Pipe	707-13
Stone Filling	733-21
Coarse Aggregate	703-02
Geotextile	737-01

**A. Pipe.** The pipe shall be corrugated plastic pipe per §706-14 or corrugated metal pipe (CMP) per §707-02 or 707-13 or other material as approved by the Engineer. The pipe shall have soil-tight or better connections. Refer to the standard sheets for direction on pipe sizes.

**B. Gravel Bags.**

**1. Bags.** Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 *Geotextile* with a strength class 1 or 2 and shall include ties. No burlap bags shall be allowed.

**2. Gravel.** Coarse aggregate used as fill shall meet the gradation requirements of size designation 1 or 2 of Table 703-4.

Each gravel bag shall be individually tied to prevent leakage.

**C. Geotextile Bedding.** Geotextile bedding shall meet the requirements of §737-01 *Geotextile* for Geotextile Bedding as described in Table 737-01A.

**D. Crushed Stone or Stone Filling.** Crushed stone or stone filling shall meet the requirements of §733-21 *Stone Filling*.

**E. Sediment Filter Logs.** A sediment filter log assembly shall consist of the sediment filter log and posts.

**1. Posts.** Posts shall be nominal 2 x 2 wood. The length of posts shall be at least 16 inches greater than the diameter of the log.

Pipe slope drain materials may consist of new or used material in satisfactory condition. Pipe couplings shall be appropriate for the pipe and as recommended by the Manufacturer. End sections may be galvanized steel or aluminum.

**209-2.08 Rolled Erosion Control Products and Soil Stabilizers.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Rolled Erosion Control Products and Soil Stabilizers	713-07
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The Type and Class shall be as specified in the contract documents.

**209-2.09 Construction Entrance/Exit-Temporary.** The materials shall meet the requirements of the following subsections of this Section and §700 *Materials and Manufacturing*.

Straw	713-19
Wood Fiber Mulch	713-11
Seeds	713-04
Water	712-01
Coarse Aggregate	703-02
Geotextiles	737-01

**A. Geotextile.** Geotextiles shall meet the requirements of §737-01 E. Geotextile Stabilization, Strength Class 1.

**B. Crushed Stone or Gravel.** Crushed stone or gravel shall meet the requirements of size designation #3 on Table 703-4.

**C. Drainage Pipes.** The drainage pipe may be steel, aluminum or polyethylene and consist of new or used material in satisfactory condition and suitable for the intended use.

**D. Fill Material.** Fill material shall meet the requirements of §733-08 *Embankment In Place*, §733-10 *Select Fill*, §733-11 *Select Granular Fill*, or §733-12 *Select Granular Fill Slope Protection*.

**E. Temporary Seed and Mulch.** Temporary Seed and Mulch shall meet the requirements of §713-19 – *Straw*, §713-11 – *Wood Fiber Mulch*, §713-04 – *Seeds* and §712-01 – *Water* .

**209-2.10 Turbidity Curtain-Temporary.** The materials shall meet the requirements of the following subsections of §700 *Materials and Manufacturing*.

Turbidity Curtain	737-01F.
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The Turbidity Curtain shall be a commercially available, pre-assembled system, including a geotextile, flotation system, bottom weight, and anchoring and securing mechanism. If assembled in panels, it shall include a secure mechanism for joining panels together. Hemmed pockets shall be sewn or heat bonded to contain flotation material, bottom weights, and for anchor lines. The flotation material shall maintain buoyancy if punctured or cut. The bottom weight shall be sufficient to hold the curtain in a vertical position. For sites not subject to tidal or heavy wave action, the curtain shall be capable of molding to conform to bottom contours so that suspended sediment is prevented from escaping underneath the curtain. Anchorage lines shall be provided of sufficient strength and number to support the curtain and maintain it in position under normally expected conditions. End anchors shall be provided, with intermediate anchor points (for stakes or anchors) such that unanchored spans do not exceed 100 feet, sufficient to maintain the turbidity curtain in place. Where the turbidity curtain is constructed in panels, anchor-line and shackle connections securing the panels together shall be sufficient for normally expected current, wind, or wave conditions.

**209-2.11 Drainage Structure Inlet Protection-Temporary.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Coarse Aggregate	703-02
Geotextiles	737-01
Sediment Filter Logs	713-20

**A. Silt Fence.** Geotextile shall meet the requirements of §737-01 G. Silt Fence and be listed in the NYSDOT Materials and Equipment Approved List (Approved List). Drainage Structure Inlet Protection assembly shall consist of silt fence geotextile, posts, frame and fasteners and may include mesh support consistent with the Approved List.

**1. Post/Frame.** Shall be 2 inch by 4 inch nominal dimension wood posts a minimum of 40 inches long.

**2. Mesh Support.** For those silt fence geotextiles on the Approved List that require a mesh support, the support shall consist of 14 gauge (minimum) welded wire mesh with a maximum 6 inch x 6 inch opening or polymeric mesh. All mesh support shall be a minimum of 28 inches in height.

**3. Fasteners.** Fasteners shall be heavy duty staples, hog rings, tie wires, or any other fastener compatible with the post material.

**B. Prefabricated.** Prefabricated drainage structure inlet protection shall be a temporary silt dike or sediment filter log.

**1. Temporary Silt Dike.** Temporary silt dikes shall be triangular in cross section, and have a height of at least 10 inches in the center with two equal sides and a 18 inch to 24 inch base. The inner material shall be urethane foam. The outer cover shall be a woven bedding type geotextile (§737-01; Table 737-01A) wrapped around the inner triangle and extends 24 inches to 36 inches beyond each side of the triangle base.

Wire staples used to secure the prefabricated check dam shall be No. 11 gauge wire and be 6 inches to 8 inches long.

**2. Sediment Filter Logs.** Sediment Filter Logs shall meet the requirements of §713-20 *Sediment Filter Logs*. A sediment filter log assembly shall consist of the sediment filter log and posts. Posts shall be nominal 2 x 2 wood and be at least 16 inches longer than the diameter of the log. Logs to be left in place will be noted on plans.

**C. Concrete Block.** Concrete blocks with holes used for inlet protection shall conform to the requirements of C 90 ASTM. Non-woven geotextile shall conform to the requirements described in §737-01C Drainage *Geotextiles*, Class A.

**1. Crushed Stone.** Crushed stone shall meet the gradation requirements of size designation 1 or 2 of Table 703-02.

**2. Hardware Cloth.** Hardware cloth wire shall meet ASTM A740-98 Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric), be 23 gauge (minimum) and have 1/4 inch or 1/2 inch openings.

**3. Geotextile Drainage Fabric.** The geotextile drainage fabric shall meet the requirements of §737-01 *Geotextile*, Table 737-01C Drainage Geotextile Requirements.

**D. Excavated.**

**1. Geotextile.** §737-01 *Geotextile*, Table 737-01C Drainage Geotextile, Class A.

**2. Crushed Stone.** §703-02 *Coarse Aggregate*, size designation 1 as described in Table 703-4.

## **209-3 CONSTRUCTION DETAILS.**

**209-3.01 General.** In the event of conflict between these requirements and pollution control laws, rules, regulations or permit conditions by other federal or state agencies, the more restrictive shall apply.

Soil erosion and sediment control shall be performed consistent with §107-12 *Water Quality Protection* and included as part of the construction schedule submitted by the Contractor in accordance with §108-01 *Start and Progress of Work*.

To the extent practicable, this work shall be coordinated with other items of work specified elsewhere in the contract documents. The intent is to assure effective and continuous erosion and sediment control throughout the construction phase and post construction to reduce the impacts of soil loss on receiving waters and adjacent properties.

Sediment controls shall be installed prior to performing grubbing, excavation, and borrow or fill operations, except for those actions necessary to install the sediment controls. The Contractor shall limit the area of clearing and grubbing, excavation, borrow and embankment operations in progress

commensurate with their capability to minimize erosion and sediment transport and keep the finish grading, mulching, seeding and other temporary and/or permanent control measures current in accordance with the approved schedule. The Engineer may determine that a potential for erosion or sediment transport exists and direct the Contractor to install temporary erosion controls earlier. When permanent soil erosion and sediment control measures cannot be installed due to seasonal or other limitations, temporary soil erosion and sediment control measures shall be installed. Prior to removing or disturbing any erosion or sediment control measure that may be required to be reestablished due to continual grading operations, the Contractor shall verify the proposed progression of operations and the reestablishment of control measures with the Engineer to ensure the continuity of erosion and sediment control. Sediment control measures shall not be removed without the Engineer's approval.

**A. Inspection and Maintenance.** Soil erosion and sediment control measures shall be inspected and maintained by the Contractor for the duration of the contract, including winter shutdown, etc. Inspection and maintenance shall continue until after the permanent stabilization measures are established and the temporary control measures are removed. The remaining disturbed area shall be permanently stabilized in accordance with the contract documents.

All temporary controls shall be inspected by the Contractor at least every seven calendar days and after each runoff event to determine if the practice is functioning as intended. All inspections shall be completed within one calendar day.

Within 1 work day from completion of the inspection, the Contractor shall:

- Repair or rebuild the practice to function as originally intended.
- Remove sediment deposition which reaches one half the height of the practice.

All sediment removed during maintenance of the practice shall be considered unsuitable material and disposed of in accordance with §203-3.01E *Unsuitable Material*. Material shall be disposed of away from sensitive resources including wetlands, water courses or other bodies of water.

Where erosion control materials have been used on final grades that have been permanently seeded, the Contractor shall care for the areas until acceptance of the Contract or acceptance of the turf, whichever is later. Where necessary, such care may include, but is not limited to providing warning signs or barricades for protection against traffic. In addition to routine maintenance, any surface that has settled, become gullied, or otherwise damaged due to the Contractor's operations shall be repaired at no additional expense to the state to reestablish the grade and soil conditions that existed prior to placing erosion control materials.

**209-3.02 Mulch-Temporary.** The Contractor shall have the capability to mulch any disturbed areas on any given day (e.g., those areas where earthwork operations are ongoing, etc.). The Contractor shall apply mulch on disturbed areas consistent with the approved project schedule or no later than seven days after grading. Straw mulch shall be spread uniformly in a continuous blanket at a rate of 2 tons per acre. Wood fiber mulch shall be applied at a rate of 1.5 tons per acre. Mulch may be spread by hand, mechanical spreaders, or blowers.

**209-3.03 Seed and Mulch-Temporary.** The Contractor shall apply seed and mulch on disturbed areas that will remain idle for more than fourteen days and regraded at a later date. The Contractor shall clean all equipment involved in seeding to remove all unwanted plants, seeds and propagules prior to starting work.

Prior to the application of seed, all areas where compaction has occurred shall be scarified. The seed bed shall be loose and friable for positive seed retention.

The Contractor shall spread ryegrass at a rate of 30 pounds per acre or cereal grasses spread at a rate of 100 pounds per acre to uniformly cover the ground. The Contractor shall evenly distribute seed by any method of sowing that does not injure the seeds in the process of spreading.

The Contractor shall spread mulch immediately following application of seed. If using straw mulch, it shall be spread uniformly in a continuous blanket at an approximate rate of 2 tons per acre by hand, or by mechanical spreaders or blowers. Mulch and seed shall not be placed simultaneously, except in the case of hydroseeding. The Contractor shall secure straw mulch to the soil surface by crimping or applying a soil stabilizer immediately after mulching, then water the seeded area. The application of water shall not result in damage to the seeded area including the redistribution of seeds (congregating seeds as a result of ponding or pooling water) or soil erosion (rilling).

The Contractor shall water the temporary seed and mulch area until seed has germinated. Maintenance of temporary seed and mulch areas shall include re-seeding, as necessary, to achieve temporary stabilization.

**209-3.04 Check Dams.** Check dams shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents. A bedding type geotextile (§737-01 *Geotextiles*) or stone (§733-21 *Stone Filling, Light* or §703-02 *Coarse Aggregate*) scour protection shall be placed as indicated in the contract documents.

Temporary Silt Dike check dams shall be attached to the ground with wire staples. Staples shall be placed according to Manufacturer's instructions.

Sediment Filter Log prefabricated check dams shall be installed according to Manufacturer's instructions. Sediment Filter Logs shall be removed at the end of the contract, unless noted otherwise in contract documents.

**209-3.05 Linear Measures.** Linear measures shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.

**A. Silt Fence-Temporary.** Silt fence shall be removed when disturbed soil upslope of the practice has been fully stabilized with permanent vegetation, pavement or stone.

**B. Sediment Filter Logs.** Sediment filter logs shall be removed when disturbed soil upslope of the practice has been fully stabilized with permanent vegetation, pavement or stone, or sediment filter logs may be left in place on long or steep slopes to provide long-term runoff control. Logs to be left in place will be noted on plans.

**209-3.06 Sediment Trap-Temporary.** Sediment traps shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.

The area under which the berm will be constructed shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared of woody vegetation. All work shall be performed in accordance with §201 *Clearing and Grubbing* and paid for separately.

**A. Gravel Bag or Sediment Filter Log Berm.** Gravel Bag or Sediment Filter Log Berms shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract drawings.

**B. Earth Berm.** The earth berm embankment shall be constructed consistent with the requirements of §203 *Excavation & Embankment*, except as herein modified. Immediately prior to placement of the impervious embankment material, the earth surface on or against which fill is to be placed, shall be thoroughly scarified to a depth of 6 inches and compacted to not less than 95 percent of Standard Proctor Maximum Density. Impervious embankment material shall then be deposited in lifts not exceeding 8 inches and compacted to not less than 95 percent of Standard Proctor Maximum Density. The moisture content of all impervious embankment material shall not be greater than 2 percent above Optimum Moisture Content as determined by AASHTO T-99 Standard Method of Test for Moisture-Density relations of Soils using a 5.5 pound Rammer and a 12 inch Drop, Method C at the time of compaction.

**C. Riser and Outlet Pipe.** The riser and outlet pipe shall be installed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.

**209-3.07 Pipe Slope Drain-Temporary.** Pipe slope drain shall be installed in accordance with the contract documents and standard sheets. Additional right-of-way may be required to accommodate this practice.

**209-3.08 Rolled Erosion Control Products and Soil Stabilizers.** Rolled Erosion Control products and Soil Stabilizers shall be installed or applied as specified in the contract documents and/or according to Manufacturer's instructions. For areas at final grade, all loose stones, clods, sticks, or other undesirable material shall be removed in accordance with the Manufacturer's recommendations or as specified in the contract documents. Where topsoil is specified, the rolled erosion control product will be installed within 2 work days of topsoil placement and soil stabilizers shall be applied according to Manufacturer's instructions.

**A. Rolled Erosion Control Products.** Construct according to the Manufacturer's recommendations and the following as minimum installation technique:

**1. Class I and Class II, Rolled Erosion Control Products.** Rolled erosion control products (RECP) shall be placed without stretching on the freshly prepared surface so that it lays loosely on the soil and is in contact with the soil at all points; and then it shall be rolled or tamped firmly into the soil surface. The upper end of each roll shall be turned down and buried to a depth of 6 inches with the soil firmly tamped against it. RECP shall be placed so that all edges shall have a minimum overlap of 6 inches. RECP shall be held tightly to the soil by anchors driven firmly into the ground. Anchors shall be spaced not more than 40 inches apart on the sides and along the centerline of all drainage ways. Unless otherwise specified in the contract documents, lengths of rolled erosion control products shall not exceed 50 feet. If the RECP needs to be spliced in the middle of a slope be sure the RECP is "shingled" with the upgrade RECP overlapping the downgrade RECP. To continue the row downslope, a new section of fabric shall be applied by burying the fabric to a depth of 6 inches with the soil firmly tamped against it, and the upper section of fabric overlapping the downslope section by a minimum of 4 inches. Seams shall be staggered at alternating elevations. RECP ends and splices shall have anchors spaced at 24 inch intervals.

**2. Class III Turf Reinforcement Mat (TRM).** Type A and Type B TRMs shall be completely filled with topsoil immediately after installation. Type C and Type D TRMs, which contain a composite, do not need to be filled with topsoil unless recommended by the Manufacturer. To prevent initial soil loss, Type A and Type B TRMs shall be covered with one of the following materials, which will be paid for separately.

For Slope application:

1. Class IV-Soil Stabilizer
2. An approved RECP (Class I or II)
3. Mulch

For Channels:

1. An approved RECP (Class I or II)

**B. Class IV Soil Stabilizers.** These materials shall be applied as recommended by the Manufacturer. Type A & B are intended to be applied with hydroseeding equipment. Type B may also be placed through dry spreading. When dry spreading method is used, the Contractor shall apply the material uniformly. Where applied, Type A shall be a minimum of 1/4 inch thick. When Type A is used in

conjunction with turf establishment, seeds must be sown separately and prior to the application of the soil stabilizer.

**209-3.09 Construction Entrance/Exit-Temporary.** Construction entrances/exits shall be placed where shown in the contract documents and constructed in accordance with the standard sheets, or as otherwise approved by the Engineer.

The Contractor shall grade, including excavating or placing fill, to prepare the original ground surface for the placement of a stabilized pad of at least 6 inches of coarse aggregate material, underlain by a geotextile. If necessary, a drainage pipe shall be installed to maintain the capacity of the ditch. The pipe dimension shall be consistent with the modified soil erosion and sediment control plan approved by the Engineer. All areas cut or filled and not stabilized by the construction Entrance/Exit material shall be covered with an erosion control treatment (temporary mulch, temporary seed and mulch, etc.) and shall be included in this pay item.

When wheel washing is performed, the washing area shall be located away from the construction entrance/exit in an area which will drain into an approved sediment control measure(s). The construction entrance/exit shall be maintained in a condition which will prevent tracking or flowing of sediment onto a paved public roadway. All sediment spilled, dropped, washed or tracked onto paved public roadway shall be removed immediately. In the event the entrance/exit is no longer performing properly (i.e. the entrance/exit aggregate becomes clogged with sediment), the Contractor shall top-dress the entrance/exit with additional coarse aggregate material.

**209-3.10 Turbidity Curtain-Temporary.**

**A. Systems Requirements.**

- 1.** For sites not subject to tidal or heavy wave action, the curtain height shall provide sufficient slack to allow the top of the curtain to rise to the maximum expected high-water level (including waves), while the bottom maintains continuous contact with the bottom of the water body. The bottom edge of the curtain shall have a weight system capable of holding the bottom of the curtain down and conforming to the water body, so as to prohibit escape of turbid water under the curtain.
- 2.** For sites subject to tidal or heavy wave action, the curtain height shall provide sufficient slack to allow the top of the curtain to rise to the maximum expected high-water level (including waves), while the bottom remains 24 inches above the bottom. The weight system shall hold the lower edge of the curtain in place so as to allow 24 inches of clearance above the bottom at mean low water, so that the curtain does not stir up sediment by repeatedly striking the bottom.
- 3.** If constructed in panels, panels shall be connected in such a manner as to prevent suspended particles passing through joints. Load lines shall be connected so as to develop the full strength of the line across the joint.
- 4.** Flotation material shall be arranged so as to be flexible and to provide continuous support.
- 5.** The flotation and curtain top shall be such as to provide a minimum of 4 inches of freeboard along the entire length of the curtain, to prohibit escape of turbid water over the top.

***B. Installation***

- 1.** The turbidity curtain shall be installed as shown in the contract documents in accordance with the Manufacturer's instructions. It shall be placed as close to the site of disturbance as possible without interfering with construction activity.



2. Turbidity curtain shall be installed and maintained in a manner that precludes passage of equipment, other than hand-held equipment or boats, to the water body outside the protected area.
3. The fully assembled turbidity curtain shall be prepared for installation by being furled and tied at intervals of 5 feet for the length of the curtain. It shall be placed and secured in the furled condition, then released to allow the bottom edge to sink.
4. At sites subject to tidal or heavy wave action, adjustment lines may be used to achieve the required height of the curtain.
5. At sites not subject to tidal or heavy wave action, excess curtain material shall lay on the bottom, away from construction activity.
6. Turbidity curtain shall be placed as nearly as possible parallel to current flow. It shall not be deployed across a flowing water course.
7. The ends of the installation shall be anchored securely well up the bank. Intermediate anchors of a type and number sufficient to hold the curtain in place under expected conditions shall be placed, and firmly fastened to the top of the curtain assembly. Maximum spacing between anchorage points shall not exceed 100 feet.
8. In situations with flow velocities that exceed 5 feet per second, use a redirection barrier. The redirection barrier shall be installed prior to installation of the turbidity curtain wherever possible, and care should be exercised in order to minimize disturbance of the bottom of the water body during installation of the redirection barrier.

### ***C. Inspection and Maintenance***

1. The turbidity curtain shall be inspected daily, with additional monitoring of performance during storms or significant flow events.
2. Any visible plume of turbid water passing beyond the curtain from the enclosed construction area shall constitute inadequate performance of the turbidity curtain. The Contractor shall immediately modify, adjust, or repair any portion of the turbidity curtain to correct inadequate performance.
3. The turbidity curtain shall remain in place until the protected construction activities have ceased and there is no visible contrast between the water being contained and the water body being protected.

### ***D. Removal.***

1. The turbidity curtain shall be removed in such a way so as to minimize release of sediment.
2. Sediment behind the curtain may be removed before removal of the curtain, if directed by the Engineer. If so, any resulting turbidity must be allowed to settle before removal proceeds.

**209-3.11 Drainage Structure Inlet Protection-Temporary.** Drainage structure inlet protection shall be placed where shown in the contract documents and constructed in accordance with the standard sheets.

## **209-4 METHOD OF MEASUREMENT.**

**209-4.01 General.** Vacant.

**209-4.02 Mulch-Temporary.** The quantity to be measured for payment will be in square yards to the nearest whole square yard of mulch-temporary installed.

**209-4.03 Seed and Mulch-Temporary.** This work will be measured in square yards to the nearest whole square yard of seed and mulch-temporary installed.

### **209-4.04 Check Dam.**

*A. Check Dam – Temporary (Stone). Stone (Temporary and Permanent).* The work will be measured as the number of stone check dams installed.”

*B. Check Dam – Gravel Bag (Temporary).* The work will be measured as the number of each gravel bag check dam installed.

**209-4.05 Linear Measures.** The work will be measured as the number of linear feet to the nearest whole linear foot of silt fence or sediment filter logs installed. No additional measurement will be made for seams or overlaps.

**209-4.06 Sediment Traps-Temporary.** The work will be measured as the number of sediment traps installed.

**209-4.07 Pipe Slope Drains-Temporary.** The work will be measured as the number of pipe slope drains installed.

**209-4.08 Rolled Erosion Control Products and Soil Stabilizers.** The work will be measured as the number of square yards to the nearest square yard of rolled erosion control products and soil stabilizers installed.

**209-4.09 Construction Entrance/Exit-Temporary.** The work will be measured as the number of square yards to the nearest square yard of construction entrance/exit installed.

**209-4.10 Turbidity Curtain-Temporary.** This work will be measured in linear feet, to the nearest whole linear foot, of turbidity curtain installed.

**209-4.11 Drainage Structure Inlet Protection-Temporary.** This work will be measured as the number of linear feet to the nearest whole linear foot of drainage structure inlet protection installed. No additional measurements will be made for seams or overlaps.

## **209-5 BASIS OF PAYMENT.**

**209-5.01 General.** The unit price bid for all work items shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work, including the cost of removal of accumulated sediment.

Progress payments will be made for all sediment control measures as follows: Seventy-five percent of the price bid will be paid after installation of Check Dams, Silt Fence-Temporary, Construction Entrance/Exit-Temporary, Drainage Structure Inlet Protection-Temporary, Sediment Filter Logs and

Turbidity Curtain-Temporary. Fifty percent of the price bid will be paid after installation of Sediment Traps and Pipe Slope Drains. The remaining percentage will be paid when the temporary practice is removed and the remaining area is permanently stabilized. Payment for Mulch-Temporary, Seed and Mulch-Temporary and Rolled Erosion Control Products and Soil Stabilizers will be paid in full after installation of the practice.

**209-5.02 Mulch-Temporary.** The unit price bid per square yard of mulch-temporary shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work.

**209-5.03 Seed and Mulch-Temporary.** The unit price bid per square yard seed and mulch-temporary shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work.

**209-5.04 Check Dams.** The unit price bid for check dams shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work.

**209-5.05 Linear Measures.** The unit price bid for silt fence-temporary or sediment filter logs shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

**209-5.06 Sediment Traps-Temporary.** The unit price bid for sediment traps-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work. Temporary seed and mulch and rolled erosion control product will be paid for separately.

**209-5.07 Pipe Slope Drains-Temporary.** The unit price bid for pipe slope drains-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work, including gravel bags, stone, sediment filter logs, manufactured silt dikes and/or other materials necessary to construct the practice.

**209-5.08 Rolled Erosion Control Products and Soil Stabilizers.** The unit price bid for rolled erosion control products and soil stabilizers shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work.

**209-5.09 Construction Entrance/Exit-Temporary.** The unit price bid for construction entrance/exit-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work. Payment will not be made for construction entrances associated with the Contractor’s facilities (e.g., staging areas, storage yards, borrow sites, etc.).

**209-5.10 Turbidity Curtain-Temporary.** The unit price bid for turbidity curtain-temporary shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

**209-5.11 Drainage Structure Inlet Protection-Temporary.** The unit price bid for drainage structure inlet protection – temporary shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item Pay Unit</b>	
209.100101	Mulch-Temporary	Square Yard
209.100102	Seed-Temporary	Square Yard
209.1003	Seed and Mulch-Temporary	Square Yard
209.110101	Check Dam (Ditch Bottom Width 0.0 to 3’), Stone-Temporary	Each
209.110102	Check Dam (Ditch Bottom Width >3’ to 6’), Stone-Temporary	Each
209.110103	Check Dam (Ditch Bottom Width >6’ to 10’), Stone-Temporary	Each
209.110104	Check Dam (Ditch Bottom Width >10’), Stone-Temporary	Each

209.110201	Check Dam (Ditch Bottom Width 0.0 to 3'), Gravel Bag-Temporary	Each
209.110202	Check Dam (Ditch Bottom Width >3' to 6'), Gravel Bag-Temporary	Each
209.110203	Check Dam (Ditch Bottom Width >6' to 10'), Gravel Bag-Temporary	Each
209.110204	Check Dam (Ditch Bottom Width >10'), Gravel Bag-Temporary	Each
209.1105	Check Dam, Prefabricated-Temporary	Foot
209.110601	Check Dam, (Ditch Bottom Width 0.0 to 3'), Stone-Permanent	Each
209.110602	Check Dam, (Ditch Bottom Width >3' to 6'), Stone-Permanent	Each
209.110603	Check Dam, (Ditch Bottom Width >6' to 10'), Stone-Permanent	Each
209.110604	Check Dam, (Ditch Bottom Width >10') Stone-Permanent	Each
209.13	Silt Fence-Temporary	Foot
209.1401nn	Sediment Trap, Earth Berm-Temporary	Each
209.1402nn	Sediment Trap, Sand Bag-Temporary	Each
209.1403nn	Sediment Trap, Ditch Dam-Temporary	Each
209.1501	Turbidity Curtain-Temporary	Foot
209.160103	Pipe Slope Drain, 12" -Temporary	Each
209.160105	Pipe Slope Drain, 18" -Temporary	Each
209.160106	Pipe Slope Drain, 24" -Temporary	Each
209.1701	Drainage Structure Inlet Protection, Silt Fence-Temporary	Foot
209.1702	Drainage Structure Inlet Protection, Gravel Bag-Temporary	Cubic Yard
209.1703	Drainage Structure Inlet Protection, Prefabricated-Temporary	Foot
209.1704	Drainage Structure Inlet Protection, Concrete Block-Temporary	Foot
209.1705	Drainage Structure Inlet Protection, Excavated-Temporary	Foot
209.1801	Rolled Erosion Control Product, Class I Type A, Short Term	Square Yard
209.1802	Rolled Erosion Control Product, Class I Type B, Short Term	Square Yard
209.1803	Rolled Erosion Control Product, Class I Type C, Short Term	Square Yard
209.1901	Rolled Erosion Control Product, Class II Type A, Intermediate	Square Yard
209.190201	Rolled Erosion Control Product, Class II Type B, Intermediate	Square Yard
209.190301	Rolled Erosion Control Product, Class II Type C, Intermediate	Square Yard
209.1904	Rolled Erosion Control Product, Class II Type D, Intermediate	Square Yard
209.200101	Turf Reinforcement Mats, Class III Type A, Permanent	Square Yard
209.200201	Turf Reinforcement Mats, Class III Type B, Permanent	Square Yard
209.200301	Turf Reinforcement Mats, Class III Type C, Permanent	Square Yard
209.200401	Turf Reinforcement Mats, Class III Type D, Permanent	Square Yard
209.2101	Soil Stabilizers, Class IV Type A	Square Yard
209.2102	Soil Stabilizers, Class IV Type B	Square Yard
209.2103	Soil Stabilizers, Class IV Type C	Square Yard
209.22	Construction Entrance/Exit	Square Yard
209.2301	Sediment Filter Log, 12"	Foot
209.2302	Sediment Filter Log, 18" to 20"	Foot
209.2303	Sediment Filter Log, 24"	Foot

NOTE: nn denotes serialized pay item. These items will be paid for within established size groups.

## **SECTION 210 - REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING MATERIAL (BUILDINGS, BRIDGES AND HIGHWAYS)**

**210-1 DESCRIPTION.** This work shall consist of removal and disposal of asbestos- containing material (ACM) from locations designated in the Contract Documents and/or where directed by the Engineer. Additional contract-specific requirements may be found on the plans or in the proposal in a Special Note entitled "Asbestos Remediation Supplemental Requirements."

**210-2 MATERIALS.** All materials used in the performance of the work shall comply with all applicable regulatory standards. Respirators and filters shall comply with NIOSH and MSHA standards. HEPA filtration systems shall comply with ANSI Z9.2-79.

**210-3 CONSTRUCTION DETAILS.** Prior to beginning any work under this item, the Contractor shall supply the Engineer with proof that the firm performing the work has a valid asbestos handling license; that its insurance coverage whether provided by the Contractor or the Asbestos Subcontractor, is consistent with §107-06 Insurance and includes an asbestos-specific, occurrence-type policy with no deductible or sunset clause; that its project supervisor is a NYSDOL certified asbestos project supervisor; that all employees engaged in the work are properly certified and have current physical examinations and respirator fit tests; and that the proper notification of work beginning on the asbestos project has been given to the New York State Department of Labor (NYSDOL) and the United States Environmental Protection Agency (USEPA). The Contractor shall schedule a coordination meeting between the Asbestos Subcontractor and the Department contracted Asbestos Project Monitor to be held at least two (2) weeks before the start of any asbestos abatement work. The meeting shall be held at the Engineer's Field Office unless otherwise approved by the Engineer.

The Contractor shall remove and dispose of ACMs in accordance with 12 NYCRR 56 or, if indicated, an approved variance thereof promulgated by the New York State Department of Labor (NYSDOL); the National Emission Standards for Hazardous Air Pollutants (NESHAP), promulgated by the United States Environmental Protection Agency (USEPA); and the Occupational Safety and Health Administration (OSHA). In the event of a conflict between these specification requirements and laws, rules and regulations of Federal, State, or local agencies, the more restrictive shall apply.

ACM shall be disposed of in accordance with 40 CFR Part 61 and all other requirements and laws, rules, and regulations of applicable Federal, State, or local agencies. Disposal sites which accept ACM for disposal shall be permitted by the New York State Department of Environmental Conservation (NYSDEC). If disposed of out-of-state, the rules, regulations, and laws of that state shall apply.

After the work is completed, the Contractor shall provide the Engineer with two copies of Daily Logs, Visitor Logs, Final Visual Inspection Logs and OSHA Air Monitoring records. The Contractor shall also provide the Engineer with a written certification that the material was disposed of in an approved waste disposal site. For friable waste this certification shall be in the form of a Waste Shipment Record. For non-friable waste this certification shall include the name and address of the waste disposal site or sites used.

**210-4 METHOD OF MEASUREMENT.** The quantity of ACM to be measured for payment will be determined by one of the following methods:

**210-4.01 Square Foot.** The quantity to be measured will be the area, measured to the nearest 0.1 square foot, of asbestos-containing material removed and disposed of.

**210-4.02 Foot.** The quantity to be measured will be the length, measured to the nearest 0.1 foot, of asbestos-containing material removed and disposed of.

**210-4.03 Lump Sum.** The quantity will be measured for payment on a lump sum basis.

**210-4.04 Fixed Price Lump Sum.** The lump sum shown in the itemized proposal for this item will be considered the price bid even though payment will be made for the work performed. Should the amount shown be altered, the altered figures will be disregarded and the original price will be used to determine the total contract bid amount. Payments will be based on one or both of the following:

**A. Agreed Price.** An Agreed Price will be based on a cost analysis submitted by the Contractor and agreed to by the State prior to performing the work. The submittal shall include a detailed estimate from the licensed asbestos removal contractor for the cost of the removal and disposal.

**B. Force Account.** A separate Force Account will be maintained for the total asbestos removal work performed on each building, structure, or highway included in the work.

**210-5 BASIS OF PAYMENT.** Payment for the work under this specification shall include all labor, materials, equipment, and asbestos-related fees and insurances necessary to satisfactorily complete the work.

Payment shall not include Work Zone Traffic Control devices outside the regulated asbestos work area.

**210-5.01 Square Foot, Foot, or Lump Sum Bid Items.** Payment for 75% of the completed quantity will be made upon the Project Monitor's written concurrence with the Contractor's certification as to the following: that the building, structure, and/or highway is visually free of asbestos; that the removal of the asbestos containing material was performed as required; that the final clearance air monitoring results meet the acceptable level specified in 12 NYCRR 56; and, that the building(s), bridge(s), and/or highway(s) are certified by the asbestos Contractor to be available for normal demolition.

The remainder of the payment for completed work will be made upon receipt by the Engineer of a certified statement from the disposal facility, signed by an official thereof, that the asbestos-containing material has been accepted and disposed of in accordance with all applicable laws, codes, rules, and regulations.

**210-5.02 Fixed Price Lump Sum.** The fixed price lump sum published in the proposal is an amount estimated by the State to be adequate to complete the work. Payments under this work will be made by Force Account or by Agreed Price, or by a combination thereof.

Payment for 75% of the Agreed Price or Force Account charges will be made upon the Project Monitor's written concurrence with the Contractor's certification that the building, structure, and/or highway is visually free of asbestos; the removal of the asbestos containing material was performed as required; that the final clearance air monitoring results meet the acceptable level specified in 12 NYCRR 56; and, that the building(s), bridge(s), and/or highway(s) are certified by the asbestos Contractor to be available for subsequent demolition and/or construction.

The remainder of the payment for completed work will be made upon receipt by the Engineer of a written certification that the ACM was disposed of in an approved waste disposal site.

Asbestos-specific insurance premiums will be reimbursed as the actual and identifiable cost of the portion of the premium attributable to the work performed under the Fixed Price Lump Sum Item. No overhead or profit will be allowed on asbestos specific insurance premiums.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
<b>Roofing (Buildings)</b>		
210.1002	Removal and Disposal of Roofing ACM	Square Foot
210.1003	Removal and Disposal of Roofing ACM	Lump Sum
210.1004	Removal and Disposal of Roofing ACM	Fixed Price Lump Sum
<b>Siding (Buildings)</b>		
210.1102	Removal and Disposal of Siding ACM	Square Foot

210.1103	Removal and Disposal of Siding ACM	Lump Sum
210.1104	Removal and Disposal of Siding ACM	Fixed Price Lump Sum

**Window Caulking and/or Glazing (Buildings)**

210.1201	Removal and Disposal of Caulk/Glazing ACM	Foot
210.1203	Removal and Disposal of Caulk/Glazing ACM	Lump Sum
210.1204	Removal and Disposal of Caulk/Glazing ACM	Fixed Price Lump Sum

**Flooring/Mastic (Buildings)**

210.1302	Removal and Disposal of Flooring/Mastic ACM	Square Foot
210.1303	Removal and Disposal of Flooring/Mastic ACM	Lump Sum
210.1304	Removal and Disposal of Flooring/Mastic ACM	Fixed Price Lump Sum

**Ceilings (Buildings)**

210.1402	Removal and Disposal of Ceiling ACM	Square Foot
210.1403	Removal and Disposal of Ceiling ACM	Lump Sum
210.1404	Removal and Disposal of Ceiling ACM	Fixed Price Lump Sum

**Thermal System Insulation (Buildings)**

210.1501	Removal and Disposal of Thermal System Insulation ACM	Foot
210.1502	Removal and Disposal of Thermal System Insulation ACM	Square Foot
210.1503	Removal and Disposal of Thermal System Insulation ACM	Lump Sum
210.1504	Removal and Disposal of Thermal System Insulation ACM	Fixed Price Lump Sum

**Miscellaneous (Buildings)**

210.2901XX	Removal and Disposal of Miscellaneous ACM	Foot
210.2902XX	Removal and Disposal of Miscellaneous ACM	Square Foot
210.2903XX	Removal and Disposal of Miscellaneous ACM	Lump Sum
210.2904XX	Removal and Disposal of Miscellaneous ACM	Fixed Price Lump Sum

**Concrete Encased Pipe (Bridges & Highways)**

210.3001	Removal and Disposal of Concrete-Encased Pipe ACM	Foot
210.3003	Removal and Disposal of Concrete-Encased Pipe ACM	Lump Sum
210.3004	Removal and Disposal of Concrete-Encased Pipe ACM	Fixed Price Lump Sum
210.3011	Removal and Disposal of Concrete-Encased Pipe ACM (BV14)	Foot
210.3013	Removal and Disposal of Concrete-Encased Pipe ACM (BV14)	Lump Sum
210.3014	Removal and Disposal of Concrete-Encased Pipe ACM (BV14)	Fixed Price Lump Sum

**Underground Pipe (Bridges & Highways)**

210.3101	Removal and Disposal of Underground Pipe ACM	Foot
210.3103	Removal and Disposal of Underground Pipe ACM	Lump Sum
210.3104	Removal and Disposal of Underground Pipe ACM	Fixed Price Lump Sum
210.3111	Removal and Disposal of Underground Pipe ACM (BV14)	Foot
210.3113	Removal and Disposal of Underground Pipe ACM (BV14)	Lump Sum

210.3114 Removal and Disposal of Underground Pipe ACM (BV14) Fixed Price Lump Sum

**Suspended Pipe (Bridges & Highways)**

210.3201 Removal and Disposal of Suspended Pipe ACM Foot  
210.3203 Removal and Disposal of Suspended Pipe ACM Lump Sum  
210.3204 Removal and Disposal of Suspended Pipe ACM Fixed Price Lump Sum  
210.3211 Removal and Disposal of Suspended Pipe ACM (BV14) Foot  
210.3213 Removal and Disposal of Suspended Pipe ACM (BV14) Lump Sum  
210.3214 Removal and Disposal of Suspended Pipe ACM (BV14) Fixed Price Lump Sum

**Bond Breaker/Filler (Bridges & Highways)**

210.3302 Removal and Disposal of Bond Breaker/Filler ACM Square Foot  
210.3303 Removal and Disposal of Bond Breaker/Filler ACM Lump Sum  
210.3304 Removal and Disposal of Bond Breaker/Filler ACM Fixed Price Lump Sum  
210.3312 Removal and Disposal of Bond Breaker/Filler ACM (BV14) Square Foot  
210.3313 Removal and Disposal of Bond Breaker/Filler ACM (BV14) Lump Sum  
210.3314 Removal and Disposal of Bond Breaker/Filler ACM (BV14) Fixed Price Lump Sum

**Caulking (Bridges & Highways)**

210.3401 Removal and Disposal of Caulking ACM Foot  
210.3403 Removal and Disposal of Caulking ACM Lump Sum  
210.3404 Removal and Disposal of Caulking ACM Fixed Price Lump Sum  
210.3411 Removal and Disposal of Caulking ACM (BV14) Foot  
210.3413 Removal and Disposal of Caulking ACM (BV14) Lump Sum  
210.3414 Removal and Disposal of Caulking ACM (BV14) Fixed Price Lump Sum

**Miscellaneous (Bridges & Highways)**

210.4801XX Removal and Disposal of Miscellaneous ACM Foot  
210.4802XX Removal and Disposal of Miscellaneous ACM Square Foot  
210.4803XX Removal and Disposal of Miscellaneous ACM Lump Sum  
210.4804XX Removal and Disposal of Miscellaneous ACM Fixed Price Lump Sum  
210.4811XX Removal and Disposal of Miscellaneous ACM (BV14) Foot  
210.4812XX Removal and Disposal of Miscellaneous ACM (BV14) Square Foot  
210.4813XX Removal and Disposal of Miscellaneous ACM (BV14) Lump Sum  
210.4814XX Removal and Disposal of Miscellaneous ACM (BV14) Fixed Price Lump Sum

**Item Number Codes**

210.xxyzXX

*where xx equals Category*

*10-28 Buildings, 29 Miscellaneous (Buildings)*

*30-47 Bridges and Highways, 48 Miscellaneous (Bridges and Highways)*

*where y equals BV*

*1-9 In order of listing within the category, 0 No BV*

*where z equals Payment Method*

*1=Foot, 2=Square Foot, 3=Lump Sum, 4=Fixed Price Lump Sum*



where XX denotes serialization (applicable to only miscellaneous items)

## SECTION 211 - INTERNALLY STABILIZED CUT STRUCTURES

**211-1 DESCRIPTION.** This work shall consist of designing, furnishing, installing, and testing an internally stabilized cut structure at the location(s) and to the elevation(s) shown in the contract documents.

**211-1.01 Soil Nail Wall System.** A Soil Nail Wall System is comprised of cement-grouted steel nail tendons, a drainage network and a facing system to internally stabilize a cut and/or underpin a structure.

### A. Soil Nail Wall System (SNWS) Definitions.

1. **Soil Nail.** A passive reinforcing element which develops its reinforcing action through nail tendon/ground interaction. A soil nail includes the SNWS nail tendon, the SNWS nail head, grout, coatings, sheathing, couplers and encapsulation if used.
2. **SNWS Nail Tendon.** A steel bar installed into a slope to reinforce and strengthen the existing ground.
3. **SNWS Nail Head.** The nail head consists of the bearing plate and headed-stud. The bearing plate distributes forces at the nail end to the wall and ground behind the facing. The headed-stud provides anchorage of the nail head into the permanent facing.
4. **Grout.** Grout is used primarily as a transfer mechanism for stresses from the wall to the ground. The grout also provides a level of corrosion protection.
5. **Centralizers.** Centralizers are devices, typically PVC, installed at various locations along the length of the nail tendon to center the bar in the excavated hole to ensure a minimum thickness of grout cover.
6. **Corrosion Protection Elements.** These are physical and/or chemical coatings or systems used to inhibit corrosion. Nail tendons may have a fusion-bonded epoxy coating applied. For maximum protection, encapsulation consists of surrounding the nail tendon with a HDPE or PVC corrugated protective sheathing and filling the internal annulus with grout. Subsequent to installing the encapsulated nail into the excavated hole, the outer annulus is also filled with grout.
7. **Temporary Wall Facing.** This consists of reinforced shotcrete installed to provide a connection between nail tendons, support the exposed soil within the nail tendon grid and provide protection against erosion and sloughing of the soil at the excavation face.
8. **Wall Drainage Network.** A system of drainage devices installed to prevent water pressure from developing behind the wall face. The system typically consists of a series of vertical geocomposite drainage strips and weep holes. Additional devices include footing drains and horizontal drains.
9. **GUTS.** The Guaranteed Ultimate Tensile Strength of the tendon.

**211-1.02 Grouted Tieback System.** A Grouted Tieback System is comprised of cement-grouted steel tendons installed to internally stabilize and supplement the resisting force of an external support system retaining a cut and/or underpinning a structure.

### A. Grouted Tieback System (GTS) Definitions.

1. **Grouted Tieback.** An active reinforcing element which transfers tensile loads from a structure to soil or rock. A grouted tieback includes all prestressing steel (tendon), the anchorage, grout, coatings, sheathing, couplers and encapsulation if used.
2. **GTS Tendon.** The steel used to transfer load from the anchorage to soil or rock.

3. **Anchorage.** That portion of the tieback, including bearing plate, nuts and wedges that is used to transfer load from the structure to a tendon.
4. **Bond Length (Fixed Length).** That portion of the tieback which is bonded to the soil or rock and transfers the tensile force from the tendon to the soil or rock.
5. **Tendon Bond Length.** The length of the tendon which is bonded to the grout. This is usually, but not necessarily, the same as the Bond Length.
6. **Stressing Length (Free Length).** That portion of the tendon which is not bonded to grout.
7. **Sheath.** That portion of the tieback which encases the tendon in the stressing length only.
8. **Encapsulation.** That portion of the tieback which encases or encapsulates the entire length of the tieback, including the sheath, to provide an additional barrier to corrosion.
9. **Pressure Grouting.** Grouting with a pressure greater than 50 psi.
10. **Alignment Load.** That load necessary to maintain position of the stressing and testing equipment.
11. **Total Movement.** The total elongation of the tieback under load, measured at the anchor head.
12. **Residual Movement.** The permanent set of the tieback resulting from stressing and releasing the tieback.
13. **Trumpet.** A steel pipe or tube, integrally attached to the bearing plate that surrounds the tendon in the vicinity of the structure.
14. **Creep Rate.** The magnitude of total movement measured during a load hold per log cycle of time.
15. **Centralizer.** A device used to center the bond length of the tieback in the hole to assure minimum grout cover over the tieback.
16. **Spacer.** A device used in strand tendons to separate each strand in the bond length to permit the grout to bond with each strand.
17. **GUTS.** The Guaranteed Ultimate Tensile Strength of the tendon.

## 211-2 MATERIALS

**211-2.01. Soil Nail Wall System (SNWS).** Ensure that the proper materials are supplied for the chosen system design.

**A. SNWS Temporary.** Provide materials meeting the following requirements:

1. **SNWS Soil Nail Tendon Assembly.** Provide components for assembling a soil nail tendon conforming to the requirements of §731-01 A. *SNWS Temporary*.
2. **SNWS Nail Grout.** Provide grout manufacture materials conforming to Table 211-1 *SNWS Nail Grout Requirements*:

TABLE 211-1 SNWS NAIL GROUT REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1, 2, 3, or 5*	§701-01
Flyash	§711-10
Water	§712-01

**\*Exception.** Where high sulfate soil conditions exist, Portland Cement is limited to Type 2 or 5 only.

- a. **Admixtures.** Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer. Acceptance will be based on the manufacturer's name appearing on the Department's Approved List. Accelerators and expansive admixtures are not permitted. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.
- 3. **SNWS Shotcrete.** Provide shotcrete conforming to the requirements of Section 583 *Shotcrete* except that all mix designs must contain Blended Portland Cement (§701-03) Type IP containing silica fume.
- 4. **SNWS Welded Wire Fabric.** Provide welded wire fabric conforming to the requirements of §709-02 *Wire Fabric for Concrete Reinforcement*. Acceptance will be based on the manufacturer's name appearing on the Department's Approved List.
- 5. **SNWS Reinforcing Bars for Shotcrete Facing.** Provide No. 5 reinforcing bars for shotcrete facing conforming to the requirements of §709-01 *Bar Reinforcement, Grade 60*. Acceptance will be based on the manufacturer's name appearing on the Department's Approved List.
- 6. **SNWS Bearing Plates / Nuts.** Provide bearing plates conforming to the requirements of §715-01 *Structural Steel*. Provide hexagonal nuts conforming to AASHTO M 291, fitted with beveled washers or spherical seat to provide uniform bearing.
- 7. **SNWS Geotextile Drainage.** Provide geotextile drainage conforming to the requirements of §737-01 *Geotextile, C. Geotextile Drainage*.
- 8. **SNWS Geocomposite Drainage Strip.** Provide geocomposite drainage strips conforming to the requirements of §737-04 *Prefabricated Composite Structural Drains*.
- 9. **SNWS Drainage Aggregate.** Provide drainage aggregate conforming to the requirements of §733-20 *Underdrain Filter Material, Type 1*.
- 10. **SNWS PVC Connector and Drain Pipes.** Provide schedule 80 PVC connector and drain pipes conforming to the requirements of §706-15 *PVC Plastic Drain Pipe System*.

**B. SNWS Permanent.** Provide materials meeting the requirements §211-2.01 A. *SNWS Temporary* with the following exceptions:

- 1. **SNWS Soil Nail Tendon Assembly.** Provide components for assembling a soil nail tendon conforming to the requirements of §731-01 B. *SNWS Permanent*.

**211-2.02. Grouted Tieback System (GTS).** Ensure that the proper materials are supplied for the chosen system design.

**A. GTS Temporary.** Provide materials meeting the following requirements:

- 1. **GTS Tieback Assembly.** Provide components for assembling a grouted tieback conforming to the requirements of §731-02 A. *GTS Temporary*.

2. **GTS Anchorage.** Provide anchorage capable of developing 95% of the GUTS and set so that only axial loads are applied. Provide bar tiebacks with spherical washers and spherical nuts at the anchorage.
3. **GTS Grout.** Provide grout manufacture materials conforming to the requirements of §211-2.01 A.2. *SNWS Nail Grout.* Epoxy resin will not be allowed as a substitute for cement grout.
  - a. **Admixtures.** Provide admixtures, if used, conforming to the requirements of §211-2.01 A.2.a. *SNWS Admixtures.*

**B. GTS Permanent.** Provide materials meeting the requirements §211-2.02 A. *GTS Temporary* with the following exceptions:

1. **GTS Tieback Assembly.** Provide components for assembling a grouted tieback conforming to the requirements of §731-02 B. *GTS Permanent.*

## 211-3 CONSTRUCTION DETAILS

### 211-3.01. Soil Nail Wall System (SNWS).

**A. SNWS Submittal.** Submit a design and design experience to the Engineer a minimum of 30 calendar days prior to start of work. Begin work only after receiving the Departments approval.

1. **Experience.** Submit as proof to the Deputy Chief Engineer Technical Services (DCETS):
  - a. Three projects for which the Contractor or subcontractor performing the work has successfully installed soil nails within the past five years,
  - b. The foreman and drill rig operators for this work have at least three years of experience, on at least three projects, in the installation of soil nails,
  - c. Written documentation listing at least five permanent structural shotcrete walls successfully completed within the past five years, and
  - d. Written documentation of the finishers and nozzle men's qualifications. Minimum qualifications include experience on at least three projects in the past three years in similar shotcrete application work. In addition, the nozzle men must demonstrate the ability to satisfactorily place the shotcrete. This will be based on either previous ACI nozzle men certification or satisfactory completion of preconstruction test panels.
2. **Working Drawings.** Submit the design and methods of construction to the DCETS for approval. The design shall be completed, sealed and stamped by a Professional Engineer.
 

Determine the soil nail length and grid spacing necessary to develop adequate load capacity to satisfy nail testing acceptance criteria for the design parameters shown in the contract documents. Provide the required partial safety factors, allowable strength factors, and minimum global stability soil factors of safety in accordance with FHWA's "Geotechnical Engineering Circular No. 7 Soil Nail Walls", Report No. FHWA-IF-03-017.

Provide working drawings conforming to the size and type requirements in accordance with §718-01 *Prestressed Concrete Units (Structural)* A. Size and Type. Include the following:

  - a. The proposed start date and proposed detailed wall construction sequence including:
    - i. Plan describing how surface water will be diverted, controlled and disposed of.

- ii.* Proposed methods and equipment for excavating the soil and/or rock to the staged excavation lifts indicated within the submitted design, including the proposed grade elevations for each excavation lift, shown on a wall elevation view.
  - iii.* Measures to ensure wall and slope stability during various stages of wall construction and excavation where discontinuous rows of nails will be installed (if applicable), information on space requirements for installation equipment, temporary shoring plans (if applicable), information on provisions for working in the proximity of underground facilities or utilities (if applicable).
  - iv.* Details of soil nail layout including lengths, grid spacing, encapsulation or epoxy coating details (if applicable) and design load (P) to resist design earth pressures.
  - v.* Proposed nail drilling methods and equipment including drillhole diameter and inclination proposed to achieve the specified pullout resistance values and any variation of these along the wall alignment.
  - b.* Nail grout mix design/shotcrete mix design including:
    - i.* Proportions of mix, including the Departments Approved List Brand Codes / Source Numbers, by weight and water-cement ratio.
    - ii.* Proposed admixtures, manufacturer, dosage, technical literature.
  - c.* Nail grout mix:
    - i.* Compressive strength test results supplied by a qualified independent testing laboratory verifying a minimum 3-day compressive strength of 1500 psi and a minimum 28-day compressive strength of 3000 psi and the corresponding density of the fluid grout performed utilizing a Baroid Mud Balance in accordance with the American Petroleum Institute (API) Recommended Practice (RP) 13B-1: *Standard Procedure for Testing Water-Based Drilling Fluids*.
  - d.* Shotcrete mix:
    - i.* Compressive strength test results supplied by a qualified independent testing laboratory verifying a minimum 3-day compressive strength of 2000 psi and a minimum 28-day compressive strength of 4000 psi.
    - ii.* Previous strength test results, from Departmental projects, for the proposed mix designs completed within 1 year of the start of construction may be substituted for initial verification of the required compressive strengths at start of production work
  - e.* Proposed nail grout placement procedures and equipment.
  - f.* Proposed nail testing methods and equipment setup including:
    - i.* Details of jacking frame and appurtenant bracing.
    - ii.* Details showing methods of isolating test nails during shotcrete application (i.e., methods to prevent bonding of the soil nail bar and the shotcrete facing during testing).
    - iii.* Details showing methods of providing the temporary unbonded length and of grouting the temporary unbonded length of test nails after completion of testing.
    - iv.* Equipment list.
  - g.* Proposed shotcrete equipment, methods of shotcrete placement, of controlling and maintaining facing alignment, and location and shotcrete thickness.
- 3. Calibrations.** Submit the following documentation to the Engineer at least 15 calendar days prior to the start of work:
- a.* Identification number and certified calibration records for each test jack and pressure gage and load cell to be used. Jack and pressure gage shall be calibrated as a unit. Calibration records shall include the date tested, device identification number, and calibration test results and shall be certified for accuracy within 2% of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.

**B. SNWS Preproduction.** Prior to the start of the soil nailed wall installation, install a nail in accordance with the contract documents for preproduction verification testing at the location specified. Test the nail after installation as specified in §211-3.01 E *SNWS Testing*.

Provide positive control and discharge of all surface water that will affect the installation of the soil nail wall throughout the construction of the wall. Include methods and schedules to be consistent with the soil erosion and sediment control plan in accordance with §209-3.01 *General*. Maintain all ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the wall, remove surface water control pipes or conduits from the site.

**C. SNWS Nail Installation.** Excavation shall be conducted in accordance with the applicable requirements of Section 206, Trench, Culvert and Structure Excavation, and the details specified in the contract documents. Excavate using procedures that prevent over-excavation, ground loss, swelling, air slaking or loosening, loss of support for completed portions of the wall, loss of soil moisture at the face, or ground freezing.

Drill holes for the soil nail installation using core drilling, rotary drilling, or auger drilling. Percussion drilling is prohibited unless approval for its use is granted by the DCETS. Install casing as required to maintain a clean and open hole. Utilize a drill bit with a diameter not smaller than the specified hole diameter minus  $\frac{1}{8}$  in. Extend the hole a minimum of 2 ft. beyond the nail length. Drill the holes to the inclination specified on the approved Working Drawings within a  $3^\circ$  tolerance.

Provide centralizers at a maximum of 10 ft. center-to-center spacing throughout the length of the nail to position the bar within 1 in. of the center of the hole and to provide a minimum 1 in. grout cover over bare or epoxy-coated bars or  $\frac{1}{2}$  in. grout cover over the encapsulation of an encapsulated nail. Size the centralizers to allow insertion of a tremie pipe to the bottom of the drillhole and to allow grout to freely flow up the drillhole. Provide a centralizer within 2 ft. of the top and bottom of the nail. Sag of the nail shall be taken into account when selecting centralizer diameter and spacing.

Insert the nail in the casing or hole after the hole is drilled to the final depth. Locate the nail within a 6 in. tolerance, in any direction. Location tolerances are applicable to only one nail and not accumulative over large wall areas.

Repair encapsulated nails that are damaged or defective in accordance with the manufacturer's recommendations or remove them from the site.

Provide a colloidal mixer and grouting equipment capable of continuous mixing and producing grout free of lumps equivalent to the strength and consistency of the approved mix design created by the independent testing laboratory. Equip the grout pump with a grout pressure gage capable of measuring at least twice but not more than three times the intended grout pressure. Size the grouting equipment to enable the entire nail to be grouted in one continuous operation. Place grout within 60 minutes after mixing or within the time recommended by the admixture manufacturer, if admixtures are used. Grout not placed in the allowed time limit will be rejected.

Perform the grouting operation after the nail is inserted. Grout each drillhole within 2 hours of completion of drilling. To prevent air voids, fill the hole with grout progressively from the bottom to the top. Completely fill the drillhole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test-bond length of proof-tested production nails.

Maintain sufficient grout level within the casing to offset the external groundwater/soil pressure and prevent hole caving during casing removal for drillholes advanced by either cased or auger methods. Maintain grout head or grout pressures sufficient to ensure that the drillhole will be completely filled with grout and to prevent unstable soil or groundwater from contaminating or diluting the grout. Control grout pressures to prevent excessive ground heave or fracturing.

Remove the grout and nail if grouting is suspended for more than 30 minutes or does not satisfy the requirements of this specification or the approved Working Drawings, and replace with fresh grout and undamaged nail bar at no additional cost.

Test nails as specified in §211-3.01 E *SNWS Testing*.

**D. SNWS Facing Elements.** Install and secure all elements of the wall drainage network as shown on the approved Working Drawings. Secure the geocomposite drainage strips tightly to the excavation face to prevent shotcrete from contaminating the ground side of the geotextile. Geocomposite drainage strips shall be continuous. Splices to the geocomposite drainage strips shall be made with a 1 ft. minimum overlap such that the flow of water is not impeded. Install all elements of the drainage network, exclusive of the wall footing drains, prior to shotcreting. Clean the face of the excavation, and other surfaces to be shotcreted, of loose material, mud, rebound, overspray, or other foreign matter that could prevent or reduce shotcrete bond. Remove material that loosens as shotcrete is applied.

Place shotcrete in accordance with the requirements of Section 583-3.03 *Placement*.

Provide shotcrete equipment capable of delivering the premixed material accurately, uniformly and continuously through the delivery hose. Control shotcrete application thickness, nozzle technique, air pressure, and rate of shotcrete placement to prevent sagging or sloughing of freshly applied shotcrete.

Ensure that the thickness of shotcrete satisfies the minimum requirements as shown on the approved Working Drawings using shooting wires, thickness control pins, or other acceptable devices. Fill all depressions along the excavated face with shotcrete at no additional cost to the State.

Repair shotcrete surface defects as soon as possible after placement. Remove and replace shotcrete which exhibits segregation, honeycombing, lamination, voids, or sand pockets. In-place shotcrete determined not to meet the specified strength requirements will be subject to remediation.

Finish shotcrete with either an undisturbed gun finish as applied from the nozzle or a rough-screeded finish.

Attach a bearing plate and nut to each nail head as shown on the approved Working Drawings. While shotcrete is still plastic and before its initial set, uniformly seat the plate on the shotcrete by hand wrench tightening the nut. Where uniform contact between the plate and the shotcrete cannot be provided, set the plate in a bed of grout. After grout has set for 24 hours, tighten the nut using a hand wrench. Ensure bearing plates with headed studs are in intimate contact with the construction facing and the studs are located within the tolerances specified herein.

Locate the SNWS facing elements from the contract documents location and dimensions within the tolerances provided in Table 211-3 *SNWS Tolerances for Facing Elements*:

<b>TABLE 211-3 SNWS TOLERANCES FOR FACING ELEMENTS</b>	
<b>Facing Element</b>	<b>Tolerance</b>
Horizontal location of wire mesh, rebar and headed studs	± 5/8 in.
Location of headed studs on bearing plate	± 1/4 in.
Spacing between reinforcing bars	± 1 in.
Reinforcing lap	± 1 in.
Shotcrete thickness	± 3/8 in.
Nail head bearing plate	± 10° deviation from parallel to the wall face

Do not excavate to the next lift until nail installation, reinforced shotcrete placement, attachment of bearing plates, and nuts and nail testing has been completed and accepted in the current lift. Ensure nail grout and shotcrete have cured for at least 72 hours or attained at least their specified 3-day compressive strength before excavating the next underlying lift.

**E. SNWS Testing.** Perform preproduction verification, verification, and proof testing of designated test nails. Perform a preproduction verification test and verification tests on sacrificial test nails as described herein. Perform proof tests on production nails at locations selected by the Engineer and as

described herein. Do not load or perform nail testing until the nail grout and shotcrete facing have cured for at least 72 hours and attained at least their specified 3-day compressive strength. Testing in less than 72 hours will only be allowed if the Contractor submits compressive strength test results, for tests performed by a qualified independent testing laboratory, verifying that the nail grout and shotcrete mixes being used will provide the specified 3-day compressive strength in the lesser time.

Provide a minimum 3 ft. temporary unbonded length in each test nail. Prior to testing, grout only the bonded length of the test nail. Determine the bonded length of the test nail based on the production nail bar grade and sized such that the allowable bar structural load is not exceeded during testing. The bond length shall not be less than 10 ft.

The maximum test load shall not exceed 80% of the GUTS of the nail. Monitor the jack load with a load cell. Provide the Engineer with the calibration curve for the load cell before start of testing.

Submit two copies of all test data to the Engineer.

1. **PreProduction Verification Test.** Perform a preproduction verification test prior to installation of production nails to verify the Contractor’s installation methods and nail pullout resistance. Testing requirements are contained in §211-3.01 E. 2. *Verification Testing*.
2. **Verification Testing.** Perform a minimum of 2 verification tests in each different soil/rock unit and for each different drilling/grouting method proposed to be used, at each wall location. Verification test nails will be sacrificial and not incorporated as production nails. Bare bars can be used for the sacrificial verification test nails.

Incrementally load verification test nails to a maximum test load of 3 times the design load (P) in accordance with Table 211-4 *SNWS Verification Test Load Schedule*. Record soil nail movements at each load increment.

TABLE 211-4 SNWS VERIFICATION TEST LOAD SCHEDULE	
Load <sup>1</sup>	Observation Period
AL	1 minute
0.25 P	10 minutes
0.50 P	10 minutes
0.75 P	10 minutes
1.00 P	10 minutes
1.25 P	10 minutes
1.50 P (Load Hold) <sup>2</sup>	60 minutes
1.75 P	10 minutes
2.00 P	10 minutes
2.50 P	10 minutes maximum
3.00 P (or failure)	10 minutes maximum
AL	1 minute (record permanent set)

<sup>1</sup>P = Design Load

AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied initially.

<sup>2</sup>The load hold portion of the verification test is a test load of 1.50 P, which shall be held constant for 60 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Maintain load during the load hold portion of the test within 2% of the intended load by use of the load cell.



All load increments shall be maintained within 5% of the intended load except as noted for the load hold portion of the test.

The Department will review all verification tests to determine if the nail is acceptable. A nail will be accepted if the following three criteria are met:

- a. A total load hold movement of less than 0.08 in. per log cycle of time between the 6 and 60 minute readings is measured during load hold testing and the creep rate is linear or decreasing throughout the load hold period.
- b. The total measured movement at the maximum test load exceeds 80% of the theoretical elastic elongation of the test nail unbonded length.
- c. A pullout failure does not occur prior to the 2.50 P load increment. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. Although the nail will be incrementally loaded to a maximum test load of 3.00 P or failure, the test is deemed acceptable if the nail adequately performs under load up to 2.00 P. The pullout failure load shall be recorded as part of the test data.

3. **Proof Testing.** Perform proof testing on a minimum of 5% (1 in 20) of the production nails in each row or a minimum of 1 per row. The locations shall be designated by the Engineer. A verification test nail successfully completed during production work shall be considered equivalent to a proof test nail and shall be accounted for in determining the number of proof tests required in that particular row.

Production proof test nails shorter than 13 ft. in length may be constructed with less than the minimum 10 ft. bond length with the unbonded length limited to 3 ft.

Incrementally load the proof test nail to a maximum test load of 1.5 times the Design Load (P) in accordance with Table 211-5 *SNWS Proof Test Load Schedule*. Record the soil nail movements at each load increment.

TABLE 211-5 SNWS PROOF TEST LOAD SCHEDULE	
Load <sup>1</sup>	Observation Period
AL	Minimum of 1 minute <sup>2</sup>
0.25 P	Minimum of 1 minute <sup>2</sup>
0.50 P	Minimum of 1 minute <sup>2</sup>
0.75 P	Minimum of 1 minute <sup>2</sup>
1.00 P	Minimum of 1 minute <sup>2</sup>
1.25 P	Minimum of 1 minute <sup>2</sup>
1.50 P (Load Hold) <sup>2</sup>	10 minutes (or 60 minutes depending on total movement <sup>3</sup> )

<sup>1</sup>P = Design Load

AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>2</sup>Hold each load increment, except for the 1.5 P load, until the deflection stabilizes.

<sup>3</sup>The load hold portion of the proof test is a maximum test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. If the total

movement between 1 minute and 10 minutes exceeds 1 mm, the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 20, 30, 50 and 60 minutes.

All load increments shall be maintained within 5% of the intended load.

The Department will review all proof tests to determine if the nail is acceptable. A nail will be accepted if the following three criteria are met:

- a.* A total load hold movement of less than 0.04 in. measured between the 1 and 10 minute readings or a total load hold movement of less than 0.08 in. is measured between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the load hold period.
- b.* The total measured movement at the maximum test load exceeds 80% of the theoretical elastic elongation of the test nail unbonded length.
- c.* A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

Successful proof-tested nails meeting the above test acceptance criteria may be incorporated as production nails, provided that:

- 1.* The unbonded length of the test nail drillhole has not collapsed during testing.
- 2.* The minimum required drillhole diameter has been maintained.
- 3.* The specified corrosion protection is provided.
- 4.* The test nail length is equal to or greater than the scheduled production nail length.

Test nails meeting the above requirements shall be completed by satisfactorily grouting up the unbonded test length. Maintaining the temporary unbonded test length for subsequent grouting is the Contractor's responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing, the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost.

For nails that are unacceptable, the Contractor shall submit a written proposal containing a suggested course of action.

Construct and attach any permanent facing and insulating materials shown in the contract documents.

### **211-3.02. Grouted Tieback System (GTS).**

**A. GTS Submittal.** Submit a design and design experience to the Engineer a minimum of 30 calendar days prior to start of work. Begin work only after receiving the Departments approval.

- 1. Experience.* Submit as proof to the DCETS: (1) the names of two projects for which the Contractor or subcontractor performing the work has successfully installed grouted tiebacks within the past two years, (2) the foreman for this work having supervised the installation of grouted tiebacks on at least two projects in the past two years. Submit proof of prior experience with the subcontractor approval process.
- 2. Working Drawings.* Submit the design and methods of construction to the DCETS for approval. The design shall be accomplished by a Professional Engineer.

Determine the tieback type, size and bond length necessary to develop adequate load capacity to satisfy grouted tieback testing Acceptance Criteria for the design loads shown in

the contract documents and in accordance with the Post Tensioning Institute *Recommendations for Prestressed Rock and Soil Anchors*. The minimum bond length shall be 10 ft. in rock and 15 ft. in soil. The minimum tendon bond length shall be 10 ft. The minimum stressing length shall be 15 ft. or as shown in the contract documents, whichever is greater. The tieback hole shall remain inside the right-of-way or easement limits shown in the contract documents.

Provide working drawings conforming to the size and type requirements in accordance with §718-01 *Prestressed Concrete Units (Structural)* A. Size and Type. Include the following:

- a. A grouted tieback schedule including:
    - i. grouted tieback number,
    - ii. design load for each tieback,
    - iii. type and size of tendon,
    - iv. total tendon length,
    - v. bond length, and tendon bond length if different from bond length,
    - vi. stressing length.
  - b. A drawing of the tieback and corrosion protection including:
    - i. spacers and their location,
    - ii. centralizers and their location,
    - iii. couplers and their location,
    - iv. stressing length corrosion protection,
    - v. bond length corrosion protection,
    - vi. anchorage and trumpet,
    - vii. anchorage corrosion protection system.
3. **Report.** Submit a report to the Engineer within 30 calendar days after completion of the tieback work. The report shall contain:
- a. as-built drawings showing the locations of the tiebacks, total tendon lengths, stressing lengths and bond lengths,
  - b. prestressing steel manufacturer's mill test reports for the tendons,
  - c. tieback installation notes (hole progression, caving, clean-out),
  - d. grouting records indicating the cement type, quantity injected and grout pressures,
  - e. tieback test results and graphs.

**B. GTS Installation.** The holes for the tiebacks may be either driven or drilled. The hole shall not be progressed in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supporting structure. If operations cause subsidence or physical damage, immediately cease operations and repair the damage. The Contractor shall immediately revise operations to prevent reoccurrence of such damage. Any and all costs incurred due to this subsidence or physical damage shall be at no additional cost to the State. If the hole will not stand open, casing shall be installed as required to maintain a clean and open hole. The hole diameter shall be no less than 3 in. if using pressure grouting in the bond length and 4 in. if not using pressure grouting. The Contractor shall provide a drill bit with a diameter no less than the specified hole diameter minus  $\frac{1}{8}$  in. The hole shall extend a minimum of 2 ft. beyond the tendon length. The holes shall be located in elevation as shown in the contract documents, within a 3 in. tolerance. The holes shall be progressed to the inclination and alignment as specified in the contract documents, within a  $\pm 3^\circ$  tolerance. All tieback holes shall be progressed perpendicular to the direction of the wall, as seen in the contract documents. Holes in rock shall be thoroughly cleaned of all dust, rock chips, grease or other material which may affect bond prior to inserting the tendon.

Strands shall not be coupled, except in the case of repairs of installed tendons or for extending stressed strand anchors.

A water-tightness test will be required for all tiebacks bonded in rock if grout is injected at a pressure of less than 50 psi. The water-tightness test shall be performed by filling the entire hole in the rock with water and subjecting it to a pressure of 5 psi as measured at the top of the hole. If the stressing length portion of hole is in soil or fractured rock, a packer or casing shall be used to allow the bond length to be pressure-tested. If the leakage rate from the hole, over a 10 minute period, exceeds 0.001 gal. of water per inch of hole diameter per foot of length of hole per minute, the hole shall be grouted, redrilled and retested. Should the subsequent water-tightness test fail, the entire process shall be repeated until results are attained which are within leakage allowances. If artesian or flowing water is encountered in the drilled hole, pressure shall be maintained on the grout until the grout has reached initial set.

The Contractor may eliminate the requirement for water-tightness tests in rock by using pressure grouting techniques. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a 50 psi grout pressure, measured at the top of the hole, can be maintained on the grout for 5 minutes without further grout injection.

In the bond length, centralizers and their installed locations shall be subject to approval by the Engineer. Centralizers shall be provided at a maximum of 10 ft. center to center spacing throughout the bond length so that not less than ½ in. of grout cover along the bond length is achieved. A centralizer shall be provided at the bottom end of the tendon. Sag of the tendon shall be taken into account when selecting centralizer diameter and spacing. Multi-element tendons shall also employ spacers at maximum 10 ft. intervals throughout the bond length to ensure grout cover on all elements.

When the contract documents require encapsulation to provide double-corrosion protection for the tendons:

1. The tendon shall be encapsulated in a grout-filled corrugated tube of one of the types stated in the Materials section of this specification. The tendon may be grouted inside the encapsulation either before or after inserting the tendon into the drill hole. The bond length of the tendon shall be centralized to provide a minimum grout cover of 3/16 in. within the tube. Spacers shall be used along the tendon bond length for multi-element tendons to ensure good bond with the encapsulation grout.
2. Centralizers shall be used to provide a minimum of 5/16 in. of grout cover over the tendon bond length encapsulation. Centralizers shall be securely attached to the encapsulation and shall be spaced at no more than 10 ft. A centralizer shall be provided at the bottom end of the tendon bond length encapsulation. A centralizer shall also be located a maximum of 5 ft. from the top of the bond length.

The bond length of the tendon shall be free of dirt, manufacturer's lubricants, corrosion-inhibiting coatings or other deleterious substances prior to installation.

The tendon shall be inserted in the casing or hole without difficulty. If the tendon cannot be completely inserted, the Contractor shall remove the tendon and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or otherwise forced into the hole. Tendons shall not be subject to sharp bends. Care shall be taken to prevent damage to the tendon's corrosion protection and centralizers during handling and installation.

The grouting equipment shall be capable of continuous mixing and shall produce grout free of lumps. The grout pump shall be equipped with a grout pressure gage capable of measuring the highest working pressures attained plus 50 psi.

The annular space between the tieback and the drilled hole up to the level of the trumpet and between the tendon and encapsulation shall be filled with grout. In order to prevent air voids in the grouting operation, the hole shall be filled with grout progressively from bottom to top. Grouting of the stressing length shall be done at low pressure. The trumpet shall not bear on the top of the stressing length grout column during testing, to ensure that load applied to the tieback during testing is not transferred to the anchorage via the grout column.

The tieback shall be centered in the trumpet so that there is no contact between the two. The corrosion protection surrounding the stressing length of the tendon shall extend up beyond the bottom seal of the trumpet but shall not contact the bearing plate or anchor head during stressing and testing.

The anchor head shall be protected from corrosion during the interim between tieback installation and final corrosion protection installation by installing a temporary cap and filling the trumpet and anchor head with corrosion-inhibiting grease. Any detrimental corrosion shall be caused for rejection.

After installation, testing and acceptance of each tieback, the trumpet shall be filled with grout or corrosion inhibiting grease and the permanent corrosion protection of the anchorage shall be installed. The Contractor shall either:

1. place a water-tight steel cap, filled with corrosion inhibiting grease or grout, over the anchor head, or
2. encase the anchor head in concrete.

**C. GTS Testing.** Each tieback shall be tested. At no time shall a test or temporary load on any tendon exceed 80% of the GUTS of the tendon. The following tests are required:

1. Performance Tests: The first two anchors installed at each specified design load capacity and 5% of the remaining anchors shall be performance tested. These tests are used to determine residual movements.
2. Creep Tests: Creep tests shall only be performed where specified by a Special Note in the contract documents. These tests are performed to determine long term deformation behavior in plastic soils.
3. Proof Tests: Proof tests shall be performed on all anchors not performance or creep tested. These tests are used to verify load capacity.
4. Lift-Off Readings: Lift-off readings shall be taken on all tiebacks after the load has been transferred to the anchorage but prior to removing the jack.
5. Lift-Off Tests: Lift-off tests shall only be performed on tiebacks in rock. If required, lift-off tests shall be performed on at least 2 tiebacks at locations to be chosen by the Engineer. Additional tests, up to 10% of the total number of tiebacks may be directed by the Engineer.

Copies of all test results and graphs shall be transmitted to the Director, Geotechnical Engineering Bureau as each test is completed.

Jacks shall have ram travel at least equal to the theoretical elastic elongation of the stressing length plus the bond length at the maximum test load, and be sufficient to accommodate wall movements. A pressure gauge shall be used with each jack. Gauges shall be calibrated with a single jack and shall not be used with any other jack. All gauges shall be accurate enough to read 100 psi changes in pressure. For performance and creep tests, the jack used shall have two calibrated gauges; a master gauge and backup gauge. The pump shall be capable of applying each load increment in less than 60 seconds.

A load cell, which has been calibrated by an independent testing laboratory within 14 days prior to the start of work and at least annually thereafter, shall be used to measure the small changes in load during the load hold portion of the performance and creep tests. There will be no substitute for the load cell on testing of the performance and creep tests. Load cells are not required for proof tests. The Contractor shall provide the Engineer with the calibration curve for the load cell prior to testing.

For the performance and creep tests, the master gauge and backup gauge shall be connected to the same pressure hose between the pump and jack and be used to measure the applied loads. If the load measured by the master gauge and backup gauge differ by more than 10%, the jack, master gauge and backup gauge shall be recalibrated as a unit at no expense to the State.

At the completion of the test the tieback load shall be adjusted to the lock-off load and transferred to the anchorage.

The movement of the tieback tendon at each load increment shall be recorded to the nearest 0.001 in. relative to an independent, fixed reference point.

- I. Performance Tests: Performance tests shall be performed by incrementally loading and unloading the tieback in accordance with Table 211-6 *GTS Performance/Creep Test Load Schedule*. Residual movements shall be taken at the alignment load for each cycle. Total movement measurements shall be taken at each load in each cycle.

<b>TABLE 211-6 GTS PERFORMANCE/CREEP TEST LOAD SCHEDULE</b>			
Cycle	Load <sup>1</sup>	<b>PERFORMANCE TEST</b>	<b>CREEP TEST</b>
		Observation Period	Observation Period
1	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	10 minutes
2	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	30 minutes
3	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.75 P	Maximum of 1 minute <sup>2</sup>	30 minutes
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
4	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.75 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.00 P	Maximum of 1 minute <sup>2</sup>	45 minutes
	0.75 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
5 <i>Temporary Tieback</i>	0.25 P	Maximum of 1 minute <sup>2</sup>	NA <sup>3</sup>
	AL	Maximum of 1 minute <sup>2</sup>	
	0.50 P	Maximum of 1 minute <sup>2</sup>	
	1.00 P	Maximum of 1 minute <sup>2</sup>	
	1.25 P	Maximum of 1 minute <sup>2</sup>	
	1.33 P (Load Hold)	50 minutes <sup>4</sup>	
	AL	Maximum of 1 minute <sup>2</sup>	
Cycle 5 is the end of the load schedule for a temporary tieback. Adjust to the lock-off load of 0.80 P (or as specified in the contract documents)			
5 <i>Permanent Tieback</i>	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.00 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.25 P	Maximum of 1 minute <sup>2</sup>	60 minutes
	1.00 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>

6 <i>Permanent Tieback</i>	0.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	0.50 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.00 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.25 P	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
	1.50 P (Load Hold)	10 minutes (or 60 minutes depending on total movement <sup>5</sup> )	300 minutes
	AL	Maximum of 1 minute <sup>2</sup>	Maximum of 1 minute <sup>2</sup>
Adjust to the lock-off load of 0.80 P (or as specified in the contract documents)			

<sup>1</sup>P = Design Load

AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>2</sup>The load shall be held at each increment just long enough to obtain the total movement reading but no longer than 1 minute.

<sup>3</sup>Creep tests determine the long-term load carrying capacity of a grouted tieback. This test is not applicable to temporary tiebacks.

<sup>4</sup>The load hold portion of the performance test for a temporary tieback is a test load of 1.33 P, which shall be held constant for 50 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 0, ½, 1, 2, 5, 10, 30, and 50 minutes. If the total movement between 1 minute and 10 minutes is less than 0.04 in., the temporary tieback will be accepted and the test may be terminated without taking the 30 and 50 minute readings.

<sup>5</sup>The load hold portion of the performance test for a permanent tieback is a test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 0.04 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

2. Creep Tests: The creep test shall be made by incrementally loading and unloading the tendon in accordance with Table 211-6 *GTS Performance/Creep Test Load Schedule*. At the highest load in each cycle the load shall be held constant in accordance with the observation periods. A load cell shall be used to monitor the constant load.

Residual movement measurements shall be taken at the alignment load for each cycle. Total movement readings shall be taken at each load in each cycle.

The times for reading the total movement during an observation period shall be 1 minute, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.

The observation period shall begin when the pump starts to load the tieback from the next lower increment.

The Contractor shall plot the tendon movement and the residual movement measured in a creep test as described for the performance test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

If the creep rates are not acceptable as defined under §211-3.02 C 6. *Acceptance Criteria*, the Contractor shall modify his installation method and perform creep tests until two successive acceptable creep tests on two different tiebacks have been performed.

3. Proof Tests: The proof tests shall be performed by loading the tieback in accordance with Table 211-7 *GTS Proof Test Load Schedule*.

<b>TABLE 211-7 GTS PROOF TEST LOAD SCHEDULE</b>			
<b>Load<sup>1</sup></b>			<b>Observation Period</b>
AL			Maximum of 1 minute <sup>2</sup>
0.25 P			Maximum of 1 minute <sup>2</sup>
0.50 P			Maximum of 1 minute <sup>2</sup>
0.75 P			Maximum of 1 minute <sup>2</sup>
1.00 P			Maximum of 1 minute <sup>2</sup>
1.25 P			Maximum of 1 minute <sup>2</sup>
Load Hold <sup>3,4</sup>	<i>Permanent Tieback</i>	1.50 P	10 minutes (or 60 minutes depending on total movement <sup>3</sup> )
	<i>Temporary Tieback</i>	1.33 P	5 minutes (or 50 minutes depending on total movement <sup>4</sup> )
Adjust to the lock-off load of 0.80 P (or as specified in the contract documents)			

<sup>1</sup>P = Design Load

AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>2</sup>The load shall be held at each increment just long enough to obtain the total movement reading but no longer than 1 minute.

<sup>3</sup>The load hold portion of the proof test for a permanent tieback is a test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 0.04 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

<sup>4</sup>The load hold portion of the proof test for a temporary tieback is a test load of 1.33 P, which shall be held constant for 5 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 0, ½, 2, and 5 minutes. If the total movement between ½ minute and 5 minutes exceeds 0.08 in., the test load shall be held for an additional 45 minutes. Total movements shall be recorded at 10, 15, 20, 25, 30, 40 and 50 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

4. Lift-Off Readings: Lift-off readings shall be taken and recorded directly after testing on all tiebacks. The load required to relieve the load from the tieback head shall be measured and recorded. If the lift-off load is not within 5% of the lock-off load the anchorage shall be reset and another lift-off reading taken.



5. Lift-Off Tests: Lift-off tests shall be performed on rock tiebacks only. Locations for lift-off tests shall be selected randomly by the Engineer prior to the commencement of any tieback testing. For each tieback subjected to a lift-off test, the Contractor shall leave an adequate length of tendon protruding over the anchorage to permit jacking.

Lift-off tests shall be performed at least 24 hours but no more than 7 days after the tieback has been set to lock-off load. The results of all lift-off tests shall be recorded.

If the lift-off load is not within 10% of the lock-off load, the anchorage shall be reset and another lift-off test performed according to the requirements in this specification.

6. Acceptance Criteria: For all grouted tiebacks:

- All tiebacks and components shall be free of detrimental corrosion.
- Lift-off readings shall show a load within 5% of the specified lock-off load.
- Lift-off tests shall show a load within 10% of the specified lock-off load.
- The total movement at the maximum test load shall exceed 80% of the theoretical elastic elongation of the unbonded length, from the alignment load to the test load.

For performance or proof tested tiebacks with a 10 minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.04 in. between 1 and 10 minutes.

For performance or proof tested tiebacks with a 60 minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.08 in. per log cycle of time.

For creep tested tiebacks, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.08 in. per log cycle of time.

For unacceptable tiebacks, the Contractor shall submit a written proposal containing a suggested course of action. The action to be taken will be subject to written approval by the Department. Tiebacks which do not meet the total movement criteria shall not be permitted to carry any load.

Conditional Acceptance Criteria: Tiebacks which meet the total movement criteria but do not meet the creep rate criteria may be accepted by the Department and locked-off at a load equal to  $\frac{1}{2} P_f$ . To determine  $P_f$  (failure load), allow the load to stabilize for 10 minutes after the tieback has failed. The load after stabilization is the failure load.

A supplemental tieback shall be installed and tested at a location approved by the Department. The combined test capacity of the tiebacks shall equal or exceed 1.5 times the original design load. That is:

$$1.5 P = 1.5 P_s + 0.5 P_f$$

Where:

- $P$  = the design load for the original tieback
- $P_s$  = the design load for the supplemental tieback
- $P_f$  = the failure load for the original tieback

For tiebacks that do not meet the lift-off reading (or test) criteria, the anchorage shall be reset and another lift-off reading (or test) taken.

## 211-4 METHOD OF MEASUREMENT

**211-4.01. Soil Nail Wall System.** A SNWS will be measured in square feet of face area measured in a vertical plane between the payment lines shown in the contract documents.

**211-4.02. Grouted Tieback System.** A GTS will be measured by the number of grouted tiebacks installed.

**211-4.03. Grouted Tieback Creep Test.** A GTS Creep Test will be measured by the number of tests performed.

## **211-5 BASIS OF PAYMENT**

**211-5.01 Soil Nail Wall System.** The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work including the wall drainage network, the temporary shotcrete construction facing and preproduction verification tests, verification tests, and proof tests of the soil nails along with successful completion of quality assurance tests indicating that the material conforms to the specification. Excavation will be paid for separately to the temporary shotcrete-soil interface and to the limits shown in the contract documents. Permanent wall facing will be paid for separately.

**211-5.02. Grouted Tieback System.** The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work including performance tests, proof tests, lift-off readings and lift-off tests of the tiebacks along with successful completion of quality assurance tests indicating that the material conforms to the specification. For tiebacks which do not meet all the acceptance criteria but do meet the conditional acceptance criteria, the original tieback and any required supplemental tiebacks(s) are, in sum, considered to be one tieback for payment purposes. No payment will be made for any additional wall connections required for installation of supplemental tiebacks. Permanent wall facing will be paid for separately.

**211-5.03. Grouted Tieback Creep Test.** The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work.

### *Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
211.01	Soil Nail Wall System (Temporary)	Square Feet
211.02	Soil Nail Wall System (Permanent)	Square Feet
211.10	Grouted Tiebacks (Temporary)	Each
211.11	Grouted Tiebacks (Permanent)	Each
211.12	Creep Test for Grouted Tiebacks	Each

## **SECTION 212 – ROCK SLOPE REINFORCEMENT AND CATCHMENT SYSTEMS**

(Last Revised January 2019)

**212-1 DESCRIPTION.** This work shall consist of furnishing and installing rock slope stabilization techniques or roadside protective measures in conformance with payment lines, type, size, and at the locations specified in the contract documents.

### **212-1.01 Definitions.**

*A. General.* As outlined in Section 203 *Excavation and Embankment*, all rock slopes shall be thoroughly scaled and cleaned of unsound material and loose masses of rock. This section provides requirements for specific techniques developed to address situations where a hazardous rock slope situation still exists after stripping and scaling in order to control a rockfall within a designated rockfall catchment area.

**B. Rock Fall.** A rockfall is the movement of rock from a slope that is so steep the rock continues to move down slope. The movement may be by free falling, bouncing, rolling or sliding.

**C. Rock Catchment Area.** The rockfall catchment area is defined as the area between the edge of roadway pavement and the base of an adjacent rockslope that is used to restrict rockfall from reaching the roadway. The term catchment area is synonymous with ditch, rockfall ditch, rockfall catch ditch and rock fallout area. The catchment area width is the horizontal distance between the roadway edge of pavement and the base (toe) of a rockslope.

**D. Rock Catchment Fences.** Rock catchment fences are techniques to control rockfalls within the R.O.W. Rock catchment fences are wire or cable mesh draped from support columns situated to define the catchment area. The catchment fence, or impact section, attenuates the rockfall energy to capture the falling rock and maintain it within the catchment area.

**E. Rock Mesh Slope Protection.** Rock mesh slope protection is a technique to control rockfalls within the R.O.W. Rock mesh slope protection is the placement of wire or cable mesh on a slope face. The mesh controls the descent of falling rock, which accumulates near the base of the slope within the catchment area.

## 212-2 MATERIALS

**212-2.01 Wire Rope Rock Catchment Fence.** The rock catchment fence system, as obtained from the manufacturer, shall have a tested capability of retaining a rock impact of 155 kip-ft of kinetic energy. The result of demonstration tests shall be furnished as required by the Engineer.

**A. Net Assembly.** Provide a fence consisting of a net conforming to §710-06 *Rock Slope Net and Wire Mesh Assemblies*, Net Assembly.

Cover all nets with chain link mesh fencing material of a minimum 11 gauge, 2 in. zinc coated mesh, conforming to the requirements of §710-02 *Galvanized Steel Fence Fabric*.

**B. Wire Ropes.** Provide the following wire ropes:

**1. Net Supporting Wire Rope.** Provide net supporting wire rope conforming to §710-27 *Rock Slope Wire Ropes*, Net Supporting Wire Rope.

**2. Seam Rope.** Provide seam rope conforming to §710-27 *Rock Slope Wire Ropes*, Seam Rope for Wire Rope Rock Catchment Fence.

**3. Tieback Restraining Cables.** Provide tieback restraining cables conforming to §710-27 *Rock Slope Wire Ropes*, Tieback Restraining Cable.

**4. Anchor Cables.** Provide anchor cables conforming to §710-27 *Rock Slope Wire Ropes*, Anchor Cable.

Braking elements in the tieback restraining cable shall incorporate a protective, crushable sleeve as recommended by the manufacturer.

**C. Support Columns.** Fabricate the net support columns from W8 x 48 wide flange members conforming to the requirements of §715-18 *Soldier Piles*.

**D. Miscellaneous Appurtenances.** All steel bolts, nuts and washers shall conform to the requirements of §723-60 *Anchor Bolts*. All miscellaneous appurtenances such as wire rope clips, thimbles, bolts, etc., shall be galvanized as supplied by the manufacturer.

#### **212-2.02 Chain Link Rock Catchment Fence.**

**A. Fence Fabric.** Provide aluminum coated steel fence fabric a minimum of 6 gauge, chain link type with twist selvage edges, conforming to the requirements of §710-04 *Aluminum Coated Steel Fence Fabric*, except for gauge.

Vinyl coated steel fence fabric shall be 6 gauge, chain link type with twist selvage edges, conforming to the requirements of §710-03 *Vinyl Coated Steel Fence Fabric*, Class A Wire Diameter, except color. The color shall be black unless otherwise specified in the contract documents.

**B. Cables.** Provide galvanized guide rail cables a minimum ¾ in. in diameter, consisting of 3 strands (7 wires per strand) conforming to the requirements of §710-22 *Cable Guide Railing* and having a minimum tensile strength of 25 kips.

**C. Posts.** Provide No. 11 steel rebar posts conforming to the requirements of §709-01 *Bar Reinforcement, Grade 420*. The rebar posts shall be galvanized in accordance with the requirements of §719-01 *Galvanized Coatings and Repair Methods*, Type I. Exposed cut ends shall be field repaired in accordance with §719-01 *Galvanized Coatings and Repair Methods*.

No. 11 steel rebar posts shall also conform to the requirements of §709-04 *Epoxy-Coated bar Reinforcement*, except color. The color shall be as specified on the plans or by the Engineer.

**D. Hook Bar Anchors.** Provide No. 9 stainless steel hook bar anchors conforming to the requirements of §709-13 *Stainless Steel Bar Reinforcement*. Hook bar anchors shall have a 180° hook with an outside diameter of 11 in.

**E. Grout.** Provide grout to fill the annular space around the No. 11 steel rebar posts, No. 9 hook bar anchors and for backfilling below the anchor angle, conforming to the requirements of §701-05 *Concrete Grouting Material*.

**F. Anchor Angles.** Provide 2 ft. long sections of anchor angles of 8 in. by 6 in. by 1 in. steel angle. The steel shall conform to the requirements of §715-01 *Structural Steel* and shall be galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods*, Type I. The anchor angle shall have two 2 in. diameter holes (for the bolts) bored through the 8 in. side. The holes shall be centered 4 in. in from each end along a line 3 in. in from the edge opposite the angle. The anchor angle shall also have three 7/8 in. diameter holes drilled on 4 in. centers along the centerline, with the middle hole located in the center of the 6 in. side for attachment of the steel turnbuckles.

**G. Resin Rock Bolt Assembly.** Provide 1 ¼ in. nominal diameter, 5 ft. long, resin rock bolt assembly conforming to the requirements of §731-03 *Rock Bolt Assembly* except resin packages of one setting time only shall be utilized for installation of the rock bolt assembly.

#### **H. Miscellaneous Appurtenances.**

**I. Thimbles.** Provide galvanized thimbles for ¾ in. guide rail cable conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail F of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

**2. Clips.** Provide galvanized cable clips for  $\frac{3}{4}$  in. guide rail cable conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail F of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

**3. Turnbuckles.** Provide galvanized steel turnbuckle cable end assemblies conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail G of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

**4. Cable Splices.** Provide galvanized cable splices conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail H of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

**5. Wedges.** Provide wedges for cable splices and cable ends conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail X of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

**6. Wire Ties.** Provide galvanized steel wire ties (12 gauge).

**7. U Bolts.** Provide galvanized and Epoxy-coated  $\frac{3}{8}$  in. x  $2\frac{1}{2}$  in. throat by  $4\frac{1}{2}$  in. depth “U” bolts as shown in Detail’s C1 & C2 of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence* with  $\frac{1}{8}$  in. thread length to clamp  $\frac{3}{4}$  in. guide rail cables to No. 11 rebar posts.

#### **212-2.03 Wire Mesh Slope Protection.**

**A. Wire Mesh.** Provide wire mesh conforming to §710-06 *Rock Slope Net and Wire Mesh Assemblies*, Wire Mesh.

**B. Cables.** Provide galvanized mesh support cables having a minimum diameter of  $\frac{3}{4}$  in., 6 x 19 Independent Wire Rope Core (IWRC) construction (or equivalent), conforming to the requirements of §710-22 *Cable Guide Railing*.

**C. Anchors.** Provide galvanized  $\frac{3}{4}$  in. diameter wire rope anchors conforming to the requirements of §710-22 *Cable Guide Railing*.

Furnish anchor centralizers consisting of plastic, steel or any material not detrimental to the anchor. Do not use wood.

**D. Grout.** Provide grout conforming to the requirements of §701-05 *Concrete Grouting Material*.

#### **E. Miscellaneous Appurtenances.**

**1. Seam Wire Rope.** Provide seam rope conforming to §710-27 *Rock Slope Wire Ropes*, Seam Rope for Wire Mesh Slope Protection.

**2. Steel Rings.** Provide 1 in. x 4 in. steel rings conforming to the requirements of Federal Specification RR-C71D Type VI.

**3. Clips.** Provide  $\frac{3}{4}$  in. wire rope clips conforming to the requirements of §710-22 *Cable Guide Railing*.

**4. Thimbles.** Provide  $\frac{3}{4}$  in. thimbles conforming to the requirements of §710-22 *Cable Guide Railing*.

#### **212-2.04 Wire Mesh Drape.**

**A. Wire Mesh Drape.** Provide wire mesh drape conforming to the requirements of §710-06 *Rock Slope Net and Wire Mesh Assemblies*, Rock Slope Wire Mesh Drape Assembly.

**B. Cables.** Provide galvanized mesh support cables a minimum  $\frac{3}{4}$  in. in diameter, consisting of 3 strands (7 wires per strand) conforming to the requirements of §710-22 *Cable Guide Railing* and having a minimum tensile strength of 25 kips.

**C. Miscellaneous Appurtenances.** Provide appurtenances, galvanized as supplied by manufacturer, as follows:

**1. Tie Wire.** Provide  $\frac{1}{12}$  in. minimum diameter steel tie wire.

**2. Hog Rings.** Provide  $\frac{1}{8}$  in. minimum diameter (11 gauge) hog rings or other steel fasteners.

**3. Steel Rings.** Provide welded forged steel rings with a stock diameter of 1 in. and a maximum inside diameter of 4 in.

**D. Resin Rock Bolt Assembly.** Provide 1  $\frac{1}{4}$  in. nominal diameter, 6  $\frac{1}{2}$  ft. long (min.), resin rock bolt assembly conforming to the requirements of §731-03 *Rock Bolt Assembly* except resin packages of one setting time only shall be utilized for installation of the mesh support and cable anchor rock bolts.

#### **212-2.05 Temporary Rock Catchment Barrier.**

**A. Precast Concrete Barrier Units.** Provide precast concrete barrier units consisting of three (3) components: precast concrete column supports, precast temporary concrete barriers, and precast concrete beams as detailed on the Standard Sheet 212-05 *Temporary Rock Catchment Barrier*.

**1. Precast Concrete Column Supports.** Provide precast concrete column supports conforming to the requirements of §704-05 *Precast Concrete Barrier* and to the dimensions and details “F”, “G”, “H”, “I”, and “N” on the Standard Sheet 212-05 *Temporary Rock Catchment Barrier*. Additional joint connection details shall be as shown on Standard Sheet 619-01 *Temporary Concrete Barrier*.

Each column support shall have cast-in-place a 6 in. x 6 in. x  $\frac{1}{4}$  in. structural steel tube to be used for support of the wire rope rock fence. The tube steel shall conform to the requirements of ASTM A500, Grade B or C, and shall conform to the dimensions and detail “N” on the Standard Sheet 212-05 *Temporary Rock Catchment Barrier*.

**2. Precast Temporary Concrete Barriers.** Provide precast temporary concrete barriers conforming to the requirements of §704-05 *Precast Concrete Barrier* and to the dimensions, joint connections, material details, and anchoring details shown on Standard Sheet 619-01 *Temporary Concrete Barrier*.

**3. Precast Concrete Beams.** Provide precast concrete beams conforming to the requirements of §704-05 *Precast Concrete Barrier* and to the dimensions and details “K”, and “M” shown on the Standard Sheet 212-05 *Temporary Rock Catchment Barrier*.

The Engineer will inspect all precast concrete barrier unit components upon delivery to the project site for conformance to specifications. Any barrier unit component having damage and/or defects in the concrete and/or joint connections will be rejected.

The precast concrete barrier units shall form a smooth and continuous barrier when joined together. Any sections damaged or misaligned while in service shall be corrected or replaced.

**B. Net Support Columns.** Fabricate the net support columns from W5 x 16 wide flange members conforming to the requirements of §715-18 *Soldier Piles*

Each support column shall have four (4) pairs (eight holes) of 1 in. diameter holes drilled on the side facing the rock slope. Two (2) holes shall be situated 3 in. from the top of the post and the remaining three (3) pairs spaced equally approximately 40 in. apart.

After any required drilling, welding and/or cutting, all support columns and related hardware shall be hot dipped galvanized in accordance with the requirements of §719-01 *Galvanized Coatings and Repair Methods*, Type I.

**C. Net Support Ropes.** Provide net support ropes conforming to §710-27 *Rock Slope Wire Ropes*, Net Supporting Wire Rope.

**D. Wire Rope Netting.** Provide wire rope netting conforming to §710-06 *Rock Slope Net and Wire Mesh Assemblies*, Net Assembly.

Two (2) aluminum stop sleeves shall be used at all locations where two individual wire ropes are joined together.

The 8 in. x 8 in. mesh size shall be fabricated using high strength, hot dipped, galvanized steel clips, which are attached so that they are non-moveable. Nets damaged during clipping shall be rejected by the Engineer.

**E. Chain Link Fence Fabric.** Provide a minimum of 9 gauge chain link fence fabric conforming to the requirements of §710-02 *Galvanized Steel Fence Fabric*. The galvanized chain link fence fabric shall be 12 ft. high and have a 2 in. mesh size. The chain link fence fabric shall be continuous between wire rope net panels.

**F. Synthetic Fabric Layer.** Provide a synthetic fabric, 10 ½ ft. in height conforming to the requirements of §737-01A *Geotextile Bedding*.

**G. Cushion Sand.** Provide sand conforming to the requirements of §703-06 *Cushion Sand*.

**H. Miscellaneous Material.** Provide miscellaneous hardware such as shackles, thimbles, wire clips, bolts, etc. which shall be hot dipped galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods*, Type I.

**212-2.06 Move Temporary Rock Catchment Barrier.** None Specified.

## 212-3 CONSTRUCTION DETAILS

**212-3.01 Wire Rope Rock Catchment Fence.** Assemble the wire rope rock catchment fence as detailed on the Standard Sheet 212-01 *Wire Rope Rock Catchment Fence*.

Submit to the Engineer for approval not less than two weeks prior to the installation of the wire rope rock catchment fence. Do not begin work prior to approval. Provide the following:

- a) Proposed start date, completion date and detailed construction sequence.
- b) Proposed anchor drilling method and equipment including hole diameter, method of keeping holes open, and hole clean out procedures.

- c) Proposed anchor installation procedure including grout placement procedures, grouting equipment, and the procedure for setting the wire rope anchor centralizers.
- d) Method of verifying anchor capacity and equipment setup including details of the jacking frame and appurtenant bracing. Include the calibration data for the stressing device. The calibration shall be performed by an independent testing laboratory within 60 calendar days of the submittal date.

Install grouted wire rope anchors with accompanying centralizers at the top of the rock slope on 12 ft. centers or as indicated by Engineer. Mix grout per manufacturer's instructions. Wait a minimum of 7 days after grouting before applying any load to the anchors. Proof test each anchor in accordance with §212-3.03 A. *Anchor Testing*.

Fasten all net braiding with high strength, corrosion resistant clips or other fasteners to produce a permanent, non-movable joint. Damage to the wire rope resulting from the installation of the clips, insofar as it affects the integrity of the system, in the opinion of the Engineer, shall be cause for rejection of the net panel.

Cut the chain link material to fit each wire rope netting panel. Attach the chain link mesh fencing material to the inside face of the wire rope nets with clips to extend a minimum of 3 ft. beyond the bottom of the fence.

Provide and install one braking element per top and bottom net supporting rope per 20 ft. net section. Position the braking element not more than 3 ft. from the column.

Use seam ropes to fasten adjacent wire rope nets and the nets to the net support wire ropes, with at least 1 wrap per 16 in.

The column spacing shall be 20 ft.

Install a tie-back restraining cable to extend from the top of each column in a direction perpendicular to the length of the fence and on the slope side of the fence. Install a braking element in each cable not more than 3 ft. from the column.

For a fence whose length is 120 ft. or less, both end columns shall have a lateral restraining cable without the braking element. This cable shall extend from the top of the column at an angle of 60° from the vertical to the ground. For a fence which is longer, install lateral restraining cables at every multiple of 120 ft., or approximately midway for a fence less than 240 ft.

Paint the fence installation where specified, with the appropriate material and color as directed by the Engineer.

**212-3.02 Chain Link Rock Catchment Fence.** Assemble the chain link rock catchment fence as detailed on the Standard Sheet 212-02 *Chain Link Rock Catchment Fence*.

Install galvanized No. 11 steel rebar posts in 2 in. diameter vertical holes drilled to a minimum depth of 2 ft. into rock. Post spacing shall be 8 ft. Pour a sufficient amount of concrete grouting material into the hole before inserting the post to allow overflow after insertion.

Install anchor angles for terminal sections. The location of the anchor angles shall be in line with the corresponding fence section and shall be determined by the angle (60° minimum) between the top longitudinal cable and the end post. The angle between any longitudinal cable and the end post shall not exceed 90°. Drill bolt holes for anchor angles into the rock spaced 16 in. on-center to a depth of 4 ft. The bolt hole diameter shall be compatible with the bolt/drill hole/resin cartridge diameter, as recommended by the bolt manufacturer, but in no case shall the bolt hole diameter exceed the resin cartridge diameter by more than 3/8 in. Install the anchor angle within 90°± 15° to the axis of the rock bolt and in intimate contact with the rock surface for its entire contact area. Acceptable methods of leveling the rock surface include the following:

- a) Chipping the rock surface.
- b) Applying a special mix supplied by the bolt manufacturer for leveling purposes.
- c) A combination of chipping and leveling.

Clean out the bolt hole to its full depth with air or water. Place the appropriate amount of resin in the hole. Insert the bolt into the hole and rotate at approximately 100 rpm while pushing the bolt down



through the resin cartridges to the bottom of the hole by a means approved by the Engineer. Rotate the bolt in this position for 30 to 60 seconds to insure mixing of the resin in the hole. Do not rotate the bolt longer than the setting time of the resin. Leave the bolts undisturbed in the hole for the time required for the resin to harden. Place the anchor angle over the bolts on the prepared surface and add the appurtenances. Tension the bolts to 40 kips by means of hollow-ram hydraulic jack, or as ordered by the Engineer. Support the base of the jack at  $90^{\circ} \pm 2^{\circ}$  to the axis of the bolt.

If a failure of the bolt or anchorage occurs, a determination of the cause of failure will be made by a Departmental Engineering Geologist. Correct, as ordered by the Engineer, at no cost to the State, failures attributable to causes other than failure of the rock in the anchorage zone.

The State reserves the right to sample and test delivered materials.

Install No. 9 stainless steel hook bar anchors on the uphill side of the fence, one hook bar anchor at each post located in a direction normal to the fence alignment. The location of the hook anchor on the ground surface shall be determined by the angle ( $60^{\circ} \pm 5^{\circ}$ ) between the tie-back cable and the post at the top longitudinal cable. Construct hook bar anchorage according to depth of overburden.

Install No. 9 stainless steel hook bar anchors at intermediate fence sections. The location of the hook bar anchors shall be in line with the corresponding fence section and shall be determined by the angle between the longitudinal cables and the intermediate anchorage post. This angle shall be between a minimum of  $60^{\circ} \pm 5^{\circ}$  and a maximum of  $90^{\circ}$ . Construct hook bar anchorages according to depth of overburden.

Secure longitudinal cables to anchor angles at terminal sections with steel turnbuckle cable end assemblies. Secure longitudinal cables at intermediate fence sections to hook bar anchors with one (1) thimble, and four (4) cable clips per cable loop. The maximum distance between terminal sections, and/or intermediate anchorage sections, shall be 200 ft.

Secure  $\frac{3}{4}$  in. longitudinal guide rail cables to rebar posts with "U" bolts so as to have minimum sag without bending posts. Cable splices shall be staggered a minimum of 20 ft. on adjacent cables. Splices shall be spaced a minimum of 100 ft. on the same cable.

Recommended installation sequence:

- a) Start with lowest longitudinal cable working from one terminal anchorage toward another or toward an intermediate anchorage, if used.
- b) Draw cable taut and secure with "U" bolt to posts.
- c) Complete tightening entire length of lower cable between anchorages before starting next higher cable.

Install aluminum fence fabric on uphill side of posts. Attach fence fabric to longitudinal cables with 12 gauge galvanized steel wire ties at 1 ft. intervals. Fence fabric splices shall be overlapped a minimum of four chain link rows. Attach fabric sections by tying both ends of the overlap at 1 ft. intervals, or by a method approved by the Engineer.

Install vinyl coated fence fabric on roadway side of posts. Attach fence fabric to longitudinal cables with 9 gauge vinyl coated steel wire ties at 1 ft. intervals. Fence fabric splices shall be overlapped a minimum of four chain link rows. Attach fabric sections by tying both ends of the overlap at 1 ft. intervals, or by a method approved by the Engineer.

Bottom of fence fabric shall be in contact with the ground surface. Add fence fabric material as necessary. Added material shall be overlapped a minimum of four chain link rows. Tie both ends of the overlap at 1 ft. intervals, or as approved by the Engineer.

Attach tie-back cables on uphill side of rebar posts after longitudinal cables have been tightened and chain link fence fabric has been installed. Tie-back cables shall have a maximum sag of  $\frac{3}{4}$  in. measured at the center.

**212-3.03 Wire Mesh Slope Protection.** Assemble the wire mesh slope protection as detailed on the Standard Sheet 212-03 *Wire Mesh Slope Protection*.

Design the grouted wire rope anchors so that the design load (P) is at least equal to 30 kips.

Submit shop drawings to the Engineer for approval not less than two weeks prior to the installation of the wire mesh slope protection. Do not begin work prior to approval. Provide drawings including the following:

- a) Proposed start date, completion date and detailed construction sequence.
- b) Details of the wire mesh and anchor layout on the existing slope.
- c) Proposed anchor drilling method and equipment including hole diameter, method of keeping holes open, and hole clean out procedures.
- d) Proposed anchor installation procedure including grout placement procedures, grouting equipment, and the procedure for setting the wire rope anchor centralizers.
- e) Method of verifying anchor capacity and equipment setup including details of the jacking frame and appurtenant bracing. Include the calibration data for the stressing device. The calibration shall be performed by an independent testing laboratory within 60 calendar days of the submittal date.

Install grouted wire rope anchors with accompanying centralizers at the top of the rock slope on 12 ft. centers or as indicated by Engineer. Mix grout per manufacturer’s instructions. Wait a minimum of 7 days after grouting before applying any load to the anchors. Proof test each anchor in accordance with §212-3.03 A. *Anchor Testing*.

Connect vertical wire rope tag lines to the anchors. Connect the horizontal support cable(s) to the vertical tag lines with steel rings as shown on the attached drawing for this specification. Do not draw cable taut. Maintain a minimum cable sag of ¾ in. on the horizontal support cable between vertical tag lines.

Attach the mesh to the horizontal support cable by a continuous weave through each of the mesh openings with galvanized 5/16 in. seam wire rope, as shown on the attached drawing for this specification.

Install the wire mesh in vertical strips. Overlay horizontal and vertical laps a minimum of 1 ft. and connect with a continuous weave through each of the mesh openings with galvanized 5/16 in. seam wire rope along the edge of the upper mesh strip. The mesh shall be installed in such a manner that the end of a roll curls into the rock face.

Install the wire mesh to cover the specified area of rock face.

**A. Anchor Testing.** Proof test each anchor. Perform the proof test by incrementally loading and unloading the anchors to 1.5 times the design load (P) in accordance with Table 212-1 *Wire Mesh Slope Protection Proof Test Load Schedule*. Record the anchor movements to the nearest 0.025 mm at each load increment.

<b>TABLE 212-1 WIRE MESH SLOPE PROTECTION PROOF TEST LOAD SCHEDULE</b>	
<u>Load<sup>1</sup></u>	<u>Observation Period</u>
AL	Minimum of 1 minute <sup>2</sup>
0.25 P	Minimum of 1 minute <sup>2</sup>
0.50 P	Minimum of 1 minute <sup>2</sup>
0.75 P	Minimum of 1 minute <sup>2</sup>
1.00 P	Minimum of 1 minute <sup>2</sup>
1.25 P	Minimum of 1 minute <sup>2</sup>
1.50 P (Load Hold) <sup>2</sup>	10 minutes (or 60 minutes depending on total movement <sup>3</sup> )

<sup>1</sup>P = Design Load

AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>2</sup>Hold each load increment, except for the 1.5 P load, until the deflection stabilizes.

<sup>3</sup>The load hold portion of the proof test is a maximum test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 1/24 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

No part of the temporary yoke or load frame shall bear within 3 ft. of the anchor.

Plot the movement versus load for each increment.

An anchor will be accepted by the Engineer if the creep rate at 1.5P does not exceed 1/24 in. between the 1 and 10 minute readings or for a load hold time of 60 minutes, the creep rate does not exceed 1/12 in. per log cycle of time. If an anchor fails the proof test, install a new anchor at no cost to the State.

**212-3.04 Wire Mesh Drape.** Assemble the wire mesh drape as detailed on the Standard Sheet 212-04 *Wire Mesh Drape*.

Install untensioned resin rock bolts at the top of the rock slope on 50 ft. centers (maximum) or as shown in the contract documents. Proof test the first rock bolt per resin lot number to 20 kips in accordance with §212-3.03 A. *Anchor Testing*.

Place ¾ in. diameter guide rail cable horizontally across the top of the rock slope, secured by 1 ¼ in. diameter resin rock bolts. Maintain a minimum cable sag of 2 ft. to 3 ft. between rock bolts. Do not draw cable taut. Splices of the guide rail cable will not be allowed.

Fold the mesh over or under the guide rail cable a minimum of 1 ft. and connect the horizontal lap with galvanized tie wire with a continuous weave through each of the mesh openings.

Install the wire mesh in vertical strips, each lapped over the other by a minimum of 1 ft. Connect the adjacent vertical strips by either a continuous weave of galvanized tie wire along the edge of the outer mesh strips only, or with hog rings or metal ties on a 6 in. staggered pattern along the edges of both panels. When used, overlay horizontal laps a minimum of 1 ft. and connect with a continuous weave of galvanized tie wire along the edge of the upper mesh strip.

Install the wire mesh to cover the area of rock face identified in the contract documents.

Repair all damaged galvanized surfaces in accordance with §719-01 *Galvanized Coatings and Repair Methods*.

**212-3.05 Temporary Rock Catchment Barrier.** Assemble and maintain the temporary rock catchment barrier as detailed on the Standard Sheet 212-05 *Temporary Rock Catchment Barrier*.

**A. Precast Concrete Barrier Units.** Each run, or bay, of precast concrete barrier units (precast concrete column support, precast temporary concrete barrier and precast concrete beam) shall be fastened together to form a continuous chain. After placement, each successive unit shall be moved longitudinally to remove any slack in the connecting joint. The units at each end of a run or bay shall be connected as shown on Standard Sheet 619-01 *Temporary Concrete Barrier*. To reduce movement of the barrier in areas where limited deflection is desired, one of the anchoring methods shown on Standard Sheet 619-01 *Temporary Concrete Barrier* shall be used. Where shown in the contract documents, the ends of the barrier run shall be fitted with an impact attenuation device or a tapered end section and flared back.

The empty space within each concrete barrier unit shall be filled with sand for the full height (32 in.) of the unit. The back of the concrete barrier units shall also be covered with sand to the full height of the unit. The sand shall then be laid back at the angle of repose of the material to a minimum sand thickness of 18 in. as shown in detail "E" on Standard Sheet 212-9 *Temporary Rock Catchment*

*Barrier.* The cost of installing and removing the sand, including the final cleaning of the pavement and shoulder, shall be included in the bid price for this Item.

The Contractor shall provide and maintain delineation of temporary barriers. This delineation shall make the barrier visible to approaching traffic, as well as to traffic which is adjacent to the barrier. The Contractor shall have the choice of using one or more of the following: warning lights, delineators, pavement marking, reflective tape placed on the barrier, reflective paint, or any other device subject to the approval of the Engineer. The delineation devices shall be maintained dirt and snow free, and be visible throughout the term of the contract including shutdown periods.

**B. Net Support Columns.** The W5 x 16 posts shall be installed in the 6 in. x 6 in. x ¼ in. structural steel tubes cast in the precast concrete column support units. The columns shall be inserted flush with the bottom of the precast concrete column supports.

**C. Net Support and Lateral Anchor Ropes.** The 5/8 in. net support wire ropes shall be installed as shown in detail “B” on Standard Sheet 212-05 *Temporary Rock Catchment Barrier*. The net support wire rope shall have maximum sag of 2 in. At both end sections and at every 125 ft. section of temporary catchment barrier (five precast concrete barrier units) install lateral anchors as shown in detail “C” on Standard Sheet 212-05 *Temporary Rock Catchment Barrier*. The wire rope loop at a ¾ in. shackle connection shall be secured with three (3) wire rope clips as shown in detail “J” on Standard Sheet 212-05 *Temporary Rock Catchment Barrier*.

**D. Rock Catchment Fence Fabric.** The rock catchment fence fabric (wire rope net, chain link fence fabric and synthetic fabric) shall be attached to the support rope after the concrete barrier units have been installed.

The wire rope net panels shall be attached to the support ropes with ¾ in. shackles spaced approximately 3 ft. apart. The chain link fence fabric, 12 ft. in height, shall be attached to the wire rope net with hog rings or twist ties. The area between two adjacent wire rope net panels shall be covered with chain link fence fabric. The layer of synthetic fabric, with a minimum height of 10 ½ ft., shall be attached to the chain link fence.

**212-3.06 Move Temporary Rock Catchment Barrier.** Move and reset the temporary rock catchment barrier in accordance with the requirements of §212-3.05 *Temporary Rock Catchment Barrier*.

#### **212-4 METHOD OF MEASUREMENTT**

**212-4.01 Wire Rope Rock Catchment Fence.** Wire rope rock catchment fence will be measured as the number of linear feet of fencing, measured from center-to-center of end posts.

**212-4.02 Chain Link Rock Catchment Fence.** Chain link rock catchment fence will be measured as the number of linear feet of fence, measured along the top of the fence between the terminal posts. An allowance of 10 linear feet will be added for each terminal section anchorage and for each intermediate section anchorage installed.

**212-4.03 Wire Mesh Slope Protection.** Wire mesh slope protection will be measured as the number of square feet of rock face satisfactorily covered. No measurement will be made of wire mesh used in any overlap.

**212-4.04 Wire Mesh Drape.** Wire mesh drape will be measured as the number of square feet of rock face satisfactorily covered. No measurement will be made of wire mesh used in any overlap.

**212-4.05 Temporary Rock Catchment Barrier.** Temporary rock catchment barrier will be measured as the number of linear feet of barrier, measured along the centerline of the uppermost concrete barrier surface, from one end anchor to the other.

**212-4.06 Move Temporary Rock Catchment Barrier.** Moving temporary rock catchment barrier will be measured as the number of linear feet of barrier moved, measured along the centerline of the uppermost concrete barrier surface, from one end anchor to the other.

**212-5 BASIS OF PAYMENT**

**212-5.01 Wire Rope Rock Catchment Fence.** The unit price bid per linear feet for wire rope rock catchment fence shall include the costs of furnishing all labor, material and equipment necessary to complete the work.

**212-5.02 Chain Link Rock Catchment Fence.** The unit price bid per linear feet for chain link rock catchment fence shall include the costs of furnishing all labor, material and equipment necessary to complete the work.

**212-5.03 Wire Mesh Slope Protection.** The unit price bid per square feet for wire mesh slope protection shall include the costs of furnishing all labor, material and equipment necessary to complete the work, including anchor testing and disposal of any material removed from the slope.

**212-5.04 Wire Mesh Drape.** The unit price bid per square feet for wire mesh drape shall include the costs of furnishing all labor, material and equipment necessary to complete the work, including anchor testing and disposal of any material removed from the slope.

**212-5.05 Temporary Rock Catchment Barrier.** The unit price bid per linear feet for temporary rock catchment barrier shall include the costs of furnishing all labor, material and equipment necessary to erect, maintain, and remove the required barrier, including any required connection devices, end treatments, delineation or guiding devices, and devices for pinning and connecting temporary precast concrete barrier units.

After placement, 90% of the item unit price will be paid. The remaining 10% will be paid when the rock catchment barrier has been removed.

**212-5.06 Move Temporary Rock Catchment Barrier.** The unit price bid per linear feet for moving temporary rock catchment barrier shall include the costs of furnishing all labor, material and equipment necessary to remove, transport, erect, and maintain the required barrier, including any required connection devices, end treatments, delineation or guiding devices, and devices for pinning and connecting temporary precast concrete barrier units.

Movements necessary to maintain, realign, or replace damaged units will not be considered as moving temporary rock catchment barrier and shall be done at no additional cost to the State.

*Payment will be made under:*

<b>Item No.</b>	<b>Item Pay</b>	<b>Unit</b>
212.0106	Wire Rope Rock Catchment Fence (Medium Impact – 6 ft.)	Feet
212.0108	Wire Rope Rock Catchment Fence (Medium Impact – 8 ft.)	Feet
212.0110	Wire Rope Rock Catchment Fence (Medium Impact – 10 ft.)	Feet
212.0112	Wire Rope Rock Catchment Fence (Medium Impact – 12 ft.)	Feet
212.0201	Chain Link Rock Catchment Fence	Feet
212.0202	Vinyl Coated Chain Link Rock Catchment Fence	Feet
212.03	Wire Mesh Slope Protection Square	Feet

212.04	Wire Mesh Drape Square	Feet
212.0501	Temporary Rock Catchment Barrier (10 ft.)	Feet
212.0502	Move Temporary Rock Catchment Barrier (10 ft.)	Feet

**SECTIONS 213 THRU 299 (VACANT)**

# Section 300

## BASES AND SUBBASES

### SECTION 301 (VACANT)

### SECTION 302 - BITUMINOUS STABILIZED COURSE

**302-1 DESCRIPTION.** This work shall consist of furnishing and placing a course of bituminous stabilized granular material and stabilized reclaimed asphalt pavement shoulder in conformance with this specification, the payment lines, and typical sections shown on the plans or as specified by the Engineer.

#### 302-2 MATERIALS

**302-2.01 General.** The Contractor has the following options in furnishing a bituminous stabilized course:

*Option A.* Furnish a granular material conforming to the requirements of Option A under §302-2.03, mixed with an asphalt emulsion conforming to §702-3201. Requests to use any asphalt emulsion other than that specified must be approved by the Director, Geotechnical Engineering Bureau. The written request must state the type of asphalt emulsion for the proposed use and be accompanied by a sample (one quart minimum) of such. The Geotechnical Engineering Bureau will require at least fourteen days to act upon the request, after receipt of the request and the sample.

*Option B.* Furnish a 3/4, 1 or 1 1/2 inch hot mix asphalt (HMA), mixed and placed in conformance with the Materials and Construction Details specified in Section 402, Hot Mix Asphalt (HMA) Pavements, except as modified herein.

*Option C.* Furnish a granular material conforming to the requirements of Option C under §302-2.03, mixed with the appropriate P.G. Binder specified in the contract and placed in accordance with the requirements of Section 402 except as modified herein. The amount of P.G. Binder for this option will be as ordered by the Engineer, but shall range between 6 and 8 percent by weight. Unless otherwise indicated by a Special Note in the Proposal, this option will be permitted only in Nassau and Suffolk Counties.

Before any Bituminous Stabilized Course is prepared, the Contractor shall take one of the following two actions:

- Notify the Engineer in writing as to which option is selected to furnish material under. Only this option will then apply for the entire project unless written approval is received from the Engineer.
- Submit to the Engineer for approval, a plan of the project delineating the areas where each option will apply. Exceptions to the approved plan during the course of the work shall be subject to advance written approval by the Engineer.

**302-2.02 Tests and Control Methods.** Materials tests and quality control methods pertaining to the work of this Section will be performed in conformance with the procedures contained in the appropriate Department publications which are current on the date of advertisement for bids. These publications are available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau.

**302-2.03 Granular Material Requirements for Options A and C.** All borrow sources of granular materials for Options A and C shall be managed in accordance with the applicable provisions of Section 203, *Borrow*.

**A. Gradation Requirements.** The material for Options A and C shall conform to Table 302-1.

**B. Soundness.** Granular materials will be accepted on the basis of a Magnesium Sulfate Soundness Loss after 4 cycles of 20 percent or less, unless other values are specified by a Special Note in the Proposal.

TABLE 302-1 GRADATION OF OPTIONS A & C, % PASSING BY WEIGHT								
Sieve Option	2 in	1 in	1/2 in	1/4 in	# 10	# 40	# 100	# 200
A	100			30-65		5-40		0-10
C		100	85-100	65-85	55-75	20-40	5-18	4-12

**C. Plasticity Index.** The plasticity index shall not exceed 5.0 for the granular material unless otherwise stated in the Proposal by a Special Note.

### 302-3 CONSTRUCTION DETAILS

**302-3.01 Weather Limitations for Option A.** This work will not be permitted on a subbase or subgrade containing frost, nor when the temperature of the surface on which the mixture is to be placed is below 45°F. All material placed under this section during any calendar year shall be mixed after March 1 of that year. No material shall be placed from the last Saturday of September to May 15, except with written permission of and under such special limitations and conditions as may be imposed by the Deputy Chief Engineer (Technical Services).

**302-3.02 Equipment for Mixing Option A.** All equipment for this work shall be subject to approval of the Engineer at all times. No work under this section will be permitted until all equipment and the processing facilities are established, inspected and approved.

Mixing shall be done with a rotating paddle shaft pugmill, providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either at a central twin shaft pugmill mixing plant by the plant mix method, or on the roadbed (or some other area approved by the Engineer) by a traveling twin shaft pugmill, whichever equipment the Contractor elects to use.

The mixer shall be either a continuous or a batch type pugmill, designed to accurately proportion either by volume or by weight, so that when the granular material and bituminous material are incorporated in the mix, a thorough and uniform coating of the granular material will result. The pugmill mixer shall be provided with weighing, volumetric or other gauging equipment which shall be capable of providing accurate control at all times of the amount of granular material entering the mixer per time interval. The mixer shall be equipped to mechanically interlock the bituminous feed with the granular material feed, such that uniformity of the mixture is assured at all times. A water pump with meter shall be available to add water to the granular material, just prior to the addition of the bituminous material.

The mixer shall be equipped with a positive displacement meter for totalizing the quantity of bituminous material applied to the mixing chamber. A by-pass valve shall be placed on the bituminous line between the positive displacement meter and the spray bar in the pugmill to permit determination of the accuracy of the positive displacement meter. The Contractor shall furnish a clean 55 gallon drum having one end completely open, and a length of flexible hose to permit filling from the by-pass valve on the bituminous line.



Traveling pugmill mixing equipment shall not be operated at speeds greater than those recommended by the manufacturer for the depth of treatment and quantity of material used.

Where the materials are mixed at a central twin shaft pugmill mixing plant, the pugmill mixing chamber shall extend at least 4 feet beyond the last point where the granular material, binder, and water are fed into the mixer, so that all materials will be completely and thoroughly mixed in the pugmill for a distance of at least 4 feet. The pugmill paddles shall be of a type adjustable for angular position on the shaft, and shall be reversible to allow retardation of the flow of the mixer, in order to control the mixing time. A dam or baffle, if approved in writing by the Director, Geotechnical Engineering Bureau may be used for the purpose of retarding flow. A mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. Sufficient clearance for a ten wheel dump truck shall be provided beneath the discharge hopper to permit calibration.

**302-3.03 Stockpiling and Sampling for Option A.** Before mixing with the bituminous material, the granular material shall be stockpiled, sampled and tested for approval as stipulated in §302-2.02.

**302-3.04 Mixing for Option A.** The proportion of bituminous material that shall be mixed with the granular material will range between 16 and 19 gallons per cubic yard, loose (uncompacted) measure. The actual proportion within this range, however, shall not be less than that determined by the Geotechnical Engineering Bureau and specified by the Engineer after the stockpiled granular material is sampled and tested. In computing the rate of application, the loose measure volume shall be determined by level filling a truck, having a minimum capacity of 8 cubic yards, with granular material. No mixing will be allowed until the temperature of the granular material is 45°F or higher.

The moisture content of the granular material, based on the material passing 3/4 inch sieve, just prior to the addition of the bituminous material, shall be in the range of 4 to 8 percent. The acceptable moisture content within this range shall be determined by the Engineer.

All granular material removed from stockpiles for introduction into continuous twin shaft or traveling twin shaft pugmill mixers shall be by side excavation for the full height of the stockpile unless otherwise approved in writing by the Director, Geotechnical Engineering Bureau.

If mixed in a traveling plant, the method of transporting and introducing granular material from approved stockpiles into the mixer shall be as approved by the Engineer.

The application temperature of the bituminous material shall be designated by the Engineer and be within the range of 130°F to 170°F.

After the granular material and bituminous material have been introduced into the pugmill, the mixing shall continue for a length of time necessary to uniformly coat the particles and to obtain a homogeneous mixture.

The discharge gates in a central plant shall not remain open during production of the stabilized mixture and shall only be opened in order to empty the hopper after the hopper becomes full. The discharged mixture may be immediately transported directly to the grade or stockpiles for later use.

The material shall be transported to the stockpile by dump truck haul. If the Contractor wishes to utilize a method other than dump truck haul to construct stockpiles, a request shall be submitted to the Director, Geotechnical Engineering Bureau. The request shall include the proposed method and type of equipment to be used.

Approval, if granted, will be based on the opinion of the Director, Geotechnical Engineering Bureau as to the capabilities of the proposal to provide a stockpile of uniformly mixed, uncontaminated material. If granted, such a waiver will remain in force only so long as all conditions for which the waiver is granted remain unchanged and a satisfactory material results.

**302-3.05 Transporting, Spreading, Compacting and Finishing of Option A.** If a central mixing plant is used, the mixture shall be transported from the mixing plant or stockpiles to the point of use in pneumatic tired vehicles, having tight bodies previously cleaned of all other materials. Approved mechanical spreading equipment shall be used for placing.

The mixture shall be spread in a thickness sufficient to produce the final compacted thickness shown on the plans. The maximum compacted thickness of any layer shall not exceed 4 inches.

After spreading, the mixture shall not be compacted until properly cured. Adequate curing shall be the responsibility of the Contractor, who shall take into account all factors, including weather and time of the year. Material that cannot be properly and adequately compacted to a stable condition shall be removed and replaced at no expense to the State. Compaction of the course shall be in accordance with the applicable provisions of §402-3.07, Compaction.

Successive layers shall not be placed until the underlying layer has been satisfactorily compacted and approved by the Engineer.

**302-3.06 Traffic.** The movement of highway traffic and construction equipment over this course may be permitted at locations designated by and in a manner under such restrictions as are ordered by the Engineer. Any damage occurring to the course as a result of traffic shall be repaired at no expense to the State as ordered by the Engineer.

**302-3.07 Care of Adjoining Pavement.** Where this course constitutes a base course for a shoulder, the Contractor shall organize the work and conduct the various operations so as to keep the surface of the adjacent pavement clean at all times, or shall bear the full expense of cleaning the pavement as ordered by the Engineer.

**302-3.08 Tolerance.** Where used as a base course supporting other pavement courses, the final surface elevation of this course shall not vary more than 1/4 inch above or below the design grade elevation at any location.

Where used as a shoulder base course, the surface elevation of this course shall not vary more than 1/4 inch above or below, true grade at any location.

**302-3.09 Maintenance.** The Contractor shall be required to maintain the bituminous stabilized course in good condition and in a manner satisfactory to the Engineer from the time work is begun until all work has been completed and accepted. Maintenance by the Contractor shall include immediate repairs of any defects, regardless of cause, that may occur.

**302-3.10 Repairs.** Repairs to the bituminous stabilized course shall be made in a manner that will assure restoration of a uniform surface and durability of the part repaired. A stabilized course that is either faulty, damaged or with low areas shall be repaired by replacing the stabilized course material to the full depth of treatment. When the extent of damage is essentially at the surface of the course and where the areas are low, the Contractor may elect to repair the course with a surface application of an approved, suitable, top course bituminous concrete mix, in lieu of a full depth material replacement.

**302-4 METHOD OF MEASUREMENT.** The quantity of Bituminous Stabilized Course to be measured for payment, will be the number of cubic yards of compacted material computed from the payment lines shown on the plans, the specifications, or as ordered by the Engineer.

**302-5 BASIS OF PAYMENT.** The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment, including bituminous material and water necessary to complete the work.

Any work by the Contractor required for the maintenance or repair of bituminous stabilized course prior to acceptance of the contract, shall be done at the Contractor's expense.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
302.01	Bituminous Stabilized Course	Cubic Yard

## SECTION 303 (VACANT)

## SECTION 304 - SUBBASE COURSE

### 304-1 DESCRIPTION

**304-1.01 General.** The work consists of furnishing, placing and compacting a subbase course of the specified type in conformity with the lines, grades, thicknesses and typical sections shown in the contract documents.

**304-1.02 Optional Type.** When the Optional Type subbase item is specified, select any of the four (4) options as follows:

*Option A.* Subbase construction consisting of two (2) separate layers of Type 4 and Type 3 Subbase Course.

*Option B.* Subbase construction consisting of a single layer of Type 1 Subbase Course.

*Option C.* Subbase construction consisting of a single layer of Type 2 Subbase Course.

*Option D.* Subbase construction consisting of a single layer of Type 4 Subbase Course.

**304-1.03 Definitions.** Deleterious: Any material that does not consist of concrete, asphalt, glass, brick, stone, sand, gravel, blast furnace slag, or other materials deemed acceptable, when these materials are used in subbase in conformance with the specification requirements, OR any material which will adversely affect the performance of the product either during handling, during construction, or in its final application.

**304-2 MATERIALS.** Provide subbase material meeting the requirements of §733-04 *Subbase Course*.

Provide a subbase material meeting the specification requirements and is within the Contractor's capabilities to place and fine grade to the required tolerances. Should the subbase course become unstable at any time prior to the placement of the overlying course, correct the unstable condition at no additional cost to the State. Perform any required modification prior to placing the material on the grade.

RAP will not be allowed as an acceptable alternate to Types 1, 3 and 4 at intersection locations or in areas with a high percentage of truck traffic as shown in the contract documents, unless Portland Cement Concrete pavement is to be installed as part of the pavement structure. A high percentage of trucks is defined to be 10% or more. For interstates and other freeways, a DDHV of 250 vph is used to indicate a high percentage of trucks.

### 304-3 CONSTRUCTION DETAILS

**304-3.01 General.** Notify the Engineer in writing of which placement option, material option (if applicable) and/or material type is proposed for use, at least 14 calendar days prior to performing the work. If it is proposed that more than one option or type is to be used, submit a plan to the Engineer describing where each option or type is proposed for use. This plan must be approved by the Engineer prior to incorporating it into the project. The State reserves the right to disapprove the use of more than one option on a project. Use uniform subbase types and materials within the limits of the roadbed as defined in §101-02 *Definition of Terms*.

**A. Winter Earthwork.** For Contractors choosing to proceed with earthwork construction operations requiring soil compaction from November 1<sup>st</sup> thru April 1<sup>st</sup>, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, in accordance with §203-3.01 A. *Winter Earthwork Submittal*. In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on frozen ground.

Winter earthwork restrictions for subbase material are such that construction operations may only proceed if the air temperature, ground temperature, and material temperature is above 32° F. Therefore, the Winter Earthwork submittal shall provide details of how standard subbase material will be placed utilizing the modified methods and procedures to adjust for the weather influence on the compaction operations.

### **304-3.02 Placement**

- Place the upper course material on the grade in a manner to minimize segregation, using equipment and procedures approved by the Engineer. Do not perform uncontrolled spreading from piles dumped on the grade.
- The maximum compacted layer thickness shall be as shown in the contract documents. In confined areas, the maximum compacted layer thickness is 6 in. The minimum loose lift thickness is 1.5 times the maximum particle size.
- Place Type 1 with a minimum compacted layer thickness of 6 in.
- Do not place Type 3 material within 4 in. of the bottom of a pavement course.
- Do not place materials blended with glass in contact with synthetic liners, geogrids, geotextiles or other geosynthetics. Ensure that glass incorporated into subbase is thoroughly mixed so that glass constitutes no more than 30 percent by weight anywhere in the subbase.
- When placing material under Option A, place and compact each material in a separate lift.

**304-3.03 Compaction.** When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements of §203-3.03 C. *Compaction*. Density tests are not required for the acceptance of these courses.

If a subbase course is disturbed by frost action prior to paving, re-compact the subbase.

**304-3.04 Traffic and Contamination.** The movement of highway traffic over the final surface of the subbase may be permitted at locations designated by, and under such restrictions as shown in the contract documents, provided such movements take place prior to the final finishing of this course to the specified tolerance. Do not allow highway traffic to move over subbase containing glass. The movement of construction equipment on this course may be permitted at locations designated by and under such restrictions as ordered by the Engineer. At locations where permission is granted for such movement, place and maintain the temporary surface of the course, upon which the construction traffic is running, at least 2 in. above the final surface of the course. Just prior to paving and after all construction traffic not required for the removal has ceased, remove the 2 in. protective layer, and prepare and compact the exposed surface of the course to the specified tolerance.

No payment will be made for furnishing, placing, maintaining, removing and disposing of the 2 in. thick protective layer. Include the cost thereof in the price bid for Subbase Course.

If the subbase is damaged or mixed with the subgrade or any other material due to the Contractor's operation, remove such material and replace it with the appropriate subbase material at no additional cost to the State.

**304-3.05 Tolerance.** Place Types 1, 2 or 4 so that after compaction the top surface of the course does not extend more than ¼ in. above nor more than ¼ in. below true grade for the course at any location. Place Type 3 course so that the finished surface does not extend above the true grade and surface for this course at any location.

### 304-4 METHOD OF MEASUREMENT

**304-4.01 Subbase Course.** The quantity is the number of cubic yards of material, computed from payment lines shown in the contract documents.

### 304-5 BASIS OF PAYMENT

**304-5.01 Subbase Course.** The unit price bid for this work includes the cost of furnishing all labor, material and equipment necessary to complete the work. Include the cost of adding water in the price bid unless the item for applying water is included in the contract. No direct payment will be made for losses of material resulting from compaction, foundation settlement, erosion, or any other cause. No deductions will be made for the volumes occupied by manholes, catch basins and other such objects.

No additional payment will be made for the protective layer, as stated in 304-3.04.

Progress payments will be made after the subbase course has been properly placed and compacted. Payment will be made at the unit price bid for 75% of the quantity. The balance of the quantity will be paid for after the final finishing to the required tolerance and just prior to the placing of the next course.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
304.11	Subbase Course, Type 1	Cubic Yards
304.12	Subbase Course, Type 2	Cubic Yards
304.13	Subbase Course, Type 3	Cubic Yards
304.14	Subbase Course, Type 4	Cubic Yards
304.15	Subbase Course, Optional Type	Cubic Yards

### SECTIONS 305 AND 306 (VACANT)

### SECTION 307 - HYDRATED LIME STABILIZED SUBGRADE

**307-1 DESCRIPTION.** Hydrated lime stabilized subgrade shall consist of the in-place subgrade soil mixed uniformly with hydrated lime and moistened, compacted and cured in accordance with these specifications, the plans and as specified by the Engineer.

#### 307-2 MATERIALS

**307-2.01 Lime Stabilization.** Materials for lime stabilization shall meet the requirements of the following:

Water	712-01
Hydrated Lime	712-04

Hydrated lime which has slaked prior to mixing, for any reason, shall not be incorporated in the work.

**307-2.02 Surface Treatment.** When a surface treatment is required to protect the completed lime stabilized course as specified in §307-3.11, the materials for surface treatment shall meet the following requirements:

Asphalt Emulsion - (RS-2)	702-3101
Coarse Aggregate - 1A size	703-02

### 307-3 CONSTRUCTION DETAILS

**307-3.01 Equipment.** No work will be permitted until all necessary equipment is on hand, inspected and approved by the Engineer.

**A. Scarifiers.** A grader-scarifier, heavy disc harrow, heavy plow or rotary pulverizing mixer shall be used for the initial scarification of the soil. The equipment shall be capable of scarifying the soil to the full depth of stabilized treatment.

**B. Mixers.** A rotary pulverizing mixer or heavy plow shall be used for all mixing of the hydrated lime with the subgrade soil. The use of a heavy plow will be permitted only if the rotary pulverizing mixer is not capable of adequately mixing the lime-soil mixture to the full depth of treatment. Rotary mixers shall be equivalent to the Seaman Duo-Stabilizer Model DS730 or the Brothers Master Mixer Model LSPRM84A.

**C. Lime Spreaders.** Spreading equipment shall be capable of uniformly distributing the lime without excess loss and at a specified rate.

**D. Compactors.** Compaction equipment shall be selected as specified in Section 203, *Compaction*.

**E. Shaping.** Shaping of the stabilized course shall be accomplished with a motor-grader or equivalent equipment capable of shaping the surface to the required tolerances specified.

**F. Finish Rolling.** A smooth steel wheel tandem roller weighing between 8 to 10 tons shall be used for the finish rolling.

**G. Water Equipment.** Water shall be added to the soil with a pressure distributor or other suitable equipment capable of uniformly distributing the required amount.

**307-3.02 Weather Limitations.** Lime stabilization of the subgrade shall not be done when the subgrade temperature is below 40°F, nor in the period from October 15 to May 15, except by written permission of and under such special limitations as set forth by the Deputy Chief Engineer (Technical Services). The hydrated lime shall not be mixed with frozen subgrade soil or when the subgrade contains frost. Lime shall not be applied when wind conditions, as determined by the Engineer, are such that blowing lime becomes objectionable or hazardous to traffic, workers, and adjacent property owners.

**307-3.03 Protection and Safety.** Before lime is spread, the Contractor shall take necessary precautions and provide necessary equipment to protect all personnel and adjacent properties from lime dust created by the lime application and mixing operations. Safety goggles and lightweight filter masks shall be provided by the Contractor to all working personnel and shall be worn at all times during these operations.

**307-3.04 Preparation of Foundation.** Prior to the addition of any lime to the subgrade, the area to be stabilized shall be graded and shaped in close conformity to the typical sections, lines and grades as shown on the plans or as specified by the Engineer. Where the depth of lime stabilization exceeds 6 inches, the subgrade soil in excess of the 6 inches depth shall be removed, placed in windrows and processed as an additional lift.

**307-3.05 Scarifying.** The subgrade soil shall be scarified 6 inches deep to the width required for stabilization. The scarified material shall be partially pulverized by making one pass through the area with a pulverizing rotary mixer. The pulverizing portion of the scarifying operation may be deleted in some

areas, where, as determined by the Engineer, the subgrade soils are excessively wet and sticky so that pulverizing with a rotary mixer is impractical.

**307-3.06 Application of Lime.** The hydrated lime shall be applied to the scarified material by an approved method and at the rate stipulated in the plans or as specified by the Engineer. A lime slurry, applied by an approved method and suitable equipment, will be permitted. Spreading equipment shall uniformly distribute the lime without excess loss. No equipment except that used for spreading and mixing shall be permitted to pass over the spread lime until it is mixed. The Engineer may require the spread lime to be sprinkled with water to reduce dusting.

**307-3.07 Primary Mixing.** After the required amount of lime has been uniformly spread, it shall be mixed into the subgrade to the full depth of treatment using a traveling rotary mixing machine or heavy plow. A minimum of three passes will be required to assure uniform incorporation of the hydrated lime. Water shall be added at the rate of up to 500 gallons/ton of lime as required for the proper consistency.

The primary mixing operation shall be completed within four hours after application of the lime. At this time, all of the lime shall be thoroughly and uniformly incorporated into the subgrade to the full depth of treatment in such a manner that the result is a homogeneous, friable mixture of subgrade soil and lime, free from clods or lumps exceeding 2 inches in size. Where the required depth of stabilization exceeds 6 inches, the windrowed material in excess of the 6 inches depth shall be spread to the required lift thickness and processed, by the addition of lime and primary mixing, as specified for the first layer. Each additional layer, where required, shall be processed similarly.

Immediately after the primary mixing operations are completed for the full depth of treatment, the surface of the subgrade shall be shaped and lightly sealed with a pneumatic tired or smooth steel wheel roller. The surface shall be crowned so as to properly shed water if rain occurs.

**307-3.08 Curing.** Following primary mixing operations, the stabilized course shall be allowed to cure for at least 24 hours plus any additional time required for the lime to properly react with the subgrade soil. Curing periods in excess of 24 hours shall be as determined and specified by the Engineer. During the curing period, the surface of the material shall be kept moist to prevent drying and cracking, and maintained in a properly sealed and crowned condition as specified by the Engineer.

**307-3.09 Secondary Mixing.** Immediately after the completion of the curing period, the stabilized course shall again be completely mixed and pulverized to the full depth of stabilization by a rotary pulverizing mixer. Secondary mixing shall continue for at least three passes or until, as determined by the Engineer, the material is properly mixed and blended. Adjustments in water content shall be made during the secondary mixing operation to obtain the proper moisture content required for compaction.

**307-3.10 Compaction, Shaping and Finishing.** Compaction of the mixture shall begin immediately after completion of the secondary mixing operations and after the proper moisture content for compaction has been obtained. Compaction shall be in accordance with the requirements of Section 203, *Compaction*. After compaction and shaping, the surface of the course shall be finished-rolled by a smooth steel wheel tandem roller weighing between 8 to 10 tons. The secondary mixing, compaction, shaping and finishing operations shall be completed within eight hours after the start of the secondary mixing.

The surface of the finished stabilized subgrade course shall not extend above design grade at any location.

The thickness of the complete hydrated lime stabilized subgrade will be determined from measurements made in test holes located at random intervals not to exceed 500 feet. The measured thickness shall not deviate from that shown on the plans or specified by the Engineer, by more than plus 1 1/2 inches or minus 1 inch. Areas of hydrated lime stabilized subgrade not meeting the specified thickness requirements shall be reconstructed.

The subbase course material shall be placed and compacted within two days after the lime stabilized subgrade course has been compacted, shaped and finished at that location. The surface of the treated subgrade shall be kept continuously moist up to the time of subbase material placement.

**307-3.11 Surface Treatment Option.** The Contractor may elect to defer placement of the subbase materials up to two weeks by placing a bituminous membrane, cationic asphalt emulsion, over the treated subgrade. The bituminous membrane must be placed within two days after the stabilized subgrade has been compacted and finished. The stabilized subgrade must be kept continuously moist prior to application of the bituminous membrane. The bituminous material shall be applied at a uniform rate of 0.2 gal/sy of treated subgrade. Where traffic is to operate on the treated subgrade, the bituminous membrane shall be chipped with a uniform coating of Size 1A aggregate applied at a rate of 15 lb/sy of treated subgrade.

#### **307-4 METHOD OF MEASUREMENT**

**307-4.01 Hydrated Lime Stabilized Subgrade.** The quantity of hydrated lime stabilized subgrade to be paid for will be the number of cubic yards of lime stabilized subgrade computed within the payment lines shown on the plans or otherwise specified in writing by the Engineer.

**307-4.02 Furnishing and Applying Hydrated Lime.** The quantity of hydrated lime to be paid for will be the number of tons of hydrated lime furnished and applied. Lime that has slaked prior to application and additional lime applied because of reduced lime content resulting from excessive thickness of the lime stabilized layer will not be measured for payment.

#### **307-5 BASIS OF PAYMENT**

**307-5.01 Hydrated Lime Stabilized Subgrade.** The unit price bid per cubic yard shall include the cost of furnishing all labor, equipment and materials necessary to complete the work, except that furnishing and applying water and hydrated lime will be paid for separately. No payment will be made for the asphalt emulsion or 1A stone chips, nor for any maintenance, repairs or reconstruction of the stabilized subgrade made before acceptance, nor for any losses of material which may result from compaction, erosion or any other causes.

**307-5.02 Furnishing and Applying Hydrated Lime.** The unit price bid for hydrated lime shall include the cost of all material, labor and equipment necessary to furnish, store, handle and apply hydrated lime in accordance with these specifications.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
307.01	Hydrated Lime Stabilized Subgrade	Cubic Yard
307.02	Furnishing and Applying Hydrated Lime	Ton

#### **SECTION 308 - SOIL CEMENT COURSE**

**308-1 DESCRIPTION.** This work shall consist of furnishing and placing a course of Portland cement stabilized soil in accordance with these specifications and in reasonably close conformance to the lines, grades, and typical sections shown on the plans or as ordered by the Engineer.

**308-2 MATERIALS.** Materials used for this item shall conform to the following Sections of these Specifications:



Portland Cement, Type 2	701-01
Asphalt Emulsion (RS-2)	702-3101
Coarse Aggregate - 1A size	703-02
Water	712-01
Calcium Chloride	712-02

Soil shall be graded from coarse to fine, free of topsoil, organic matter, and substances deleterious to the normal hardening of the soil cement mixture, and shall be subject to the approval of the Engineer at all times. The soil will be sampled by the Engineer prior to use and submitted to the Geotechnical Engineering Bureau to determine both its suitability and the cement content to be used. Frozen soil or soil containing frost shall not be used.

The soil material shall be stockpiled, sampled and tested before mixing in conformance with material tests and quality control methods contained in the appropriate Department publications which are current on the date of advertisement for bids. These publications are available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau.

### **308-3 CONSTRUCTION DETAILS**

**308-3.01 Equipment.** No work under this item will be permitted until all equipment and facilities involved are established, inspected and approved by the Engineer.

The materials shall be mixed in a central twin-shaft pugmill mixing plant or mixed on the roadbed by a traveling pugmill, whichever equipment the Contractor elects to use. Traveling pugmill mixing equipment shall not be operated at speeds greater than those recommended by the manufacturer for the depth of treatment and quantity of materials to be mixed.

Where the materials are mixed in a central twin-shaft pugmill mixing plant, the mixing area of the pugmill shall extend at least 4 feet beyond the last point where the soil, cement, or water are fed into the mixer, so that all materials will be completely and thoroughly mixed in the pugmill for a distance of at least 4 feet. The paddles of the pugmill shall be adjustable for angular position on the shaft, and shall be reversible to retard the flow of mixture in order to control the mixing time. Where the materials are mixed at a central twin-shaft mixing plant, a hydraulically or mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. Sufficient clearance for a ten-wheel dump truck shall be provided underneath the hopper.

The central mixer shall be either a continuous or batch type pugmill, and shall be designed to accurately proportion the mix either by volume or by weight. The pugmill mixer shall be provided with weighing, volumetric or other gauging equipment, which shall be capable of providing accurate control at all times of the amounts of soil and cement entering the mixer per time interval. The mixer shall be equipped with a method of mechanically interlocking the cement feed with the soil feed so that uniformity of the mixture will be assured at all times. A water pump and meter arrangement shall be available for addition of water to the soil and cement. The water supply line shall have a 90° T connection with a valve immediately downstream of the flow meter for calibration purposes. The meter shall be calibrated at least once a year under the direction of Department personnel.

A smooth steel wheel roller and a self-propelled pneumatic tired or self-propelled vibratory compactor shall be used for compaction. The minimum number of passes shall be determined by the Engineer, after field tests, and shall be such as to produce the specified minimum density for the full depth of the course. Cleated or tracked equipment will not be permitted on the soil cement course. In areas inaccessible to pneumatic tired compactors, or where maneuvering space is limited, impact rammers and/or vibratory equipment may be used provided the required density is obtained.

Equipment suitable for storing, handling, weighing, measuring, proportioning, controlling and applying or spreading the cement shall be used.

Equipment suitable for accurately metering, controlling and applying the water shall be used. If a pugmill mixer is used, all necessary water for mixing shall be added in the pugmill. If a rotary mixer is permitted and used, water for mixing shall be added through a spray bar in the mixing chamber.

**308-3.02 Weather Limitations.** Soil Cement Course shall not be placed between October 15 and May 15 nor when the air temperature in the shade is 40°F or lower. Soil cement course shall not be placed upon a frozen surface.

**308-3.03 Preparation of Foundation.** Before soil cement operations are begun, the area upon which the soil cement course is to be placed shall be graded, shaped, and compacted as required in conformance with the grades, lines, thicknesses and typical sections shown on the plans or as ordered by the Engineer.

The subgrade and any preceding course shall be compact and suitable to support the construction and compaction equipment without settlement or displacement. Soft or yielding subgrade shall be corrected and made stable before the soil cement course is placed.

**308-3.04 Application of Calcium Chloride and Cement.** Where required by a Special Note in the Proposal, the specified quantity of calcium chloride ordered by the Engineer in flake form shall be uniformly added to the soil before adding the cement.

Portland cement, in the amount ordered by the Engineer, shall be added uniformly to the soil material. The amount of cement ordered by the Engineer will range generally between 8 percent and 10 percent by weight.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform mixture of soil and cement during mixing operations and shall not exceed the optimum moisture content for the soil cement mixture, as determined by the Engineer.

Where a traveling pugmill mixer is used, cement that has been displaced or removed from the windrow regardless of cause, shall be replaced before mixing is started, at the Contractor's expense.

**308-3.05 Mixing and Spreading.** Immediately prior to mixing, the soil shall have a minimum temperature of 40°F. After the cement has been applied to the soil, it shall be immediately mixed with the soil. Mixing shall continue until the cement has been thoroughly blended with the soil to prevent the formation of cement balls when the water is applied. Immediately after the soil and cement have been thoroughly mixed, the full amount of water shall be applied uniformly and mixing shall be continued until an intimate and homogeneous blend of soil, cement and water has been obtained.

When water application and mixing have been completed, the percentage of moisture in the mixture based on oven-dry weights, shall not be below, nor more than 2 percent above, the specified optimum moisture content determined by the Engineer.

In order to minimize segregation of the mix, the discharge gates shall be kept closed until the hopper is filled to at least one-half of its capacity. After the hopper is emptied, the gates shall be closed until the hopper is refilled. The material shall then be discharged into clean trucks and transported directly to the grade.

The soil cement shall be spread on an accepted subgrade or preceding course immediately after mixing. If mixed in a central plant, approved mechanical spreading equipment shall be used and not more than 30 minutes shall elapse between the time of mixing the cement and the start of the compaction operation.

In case of rain between the time of adding cement and final finishing, the Engineer shall be the sole judge of what areas involved are satisfactory and what areas are not acceptable. Areas not acceptable to the Engineer shall be removed to the full depth of the soil cement course and properly replaced at the Contractor's expense for all labor, materials and equipment involved.

**308-3.06 Compaction.** Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth on the subbase course. As an immediate continuation of mixing operations, and after an

initial breakdown pass with a smooth steel wheel roller, the loose mixture then shall be uniformly compacted, by a self-propelled pneumatic tired or self propelled vibratory compactor, to the specified density. All areas and portions of this course shall be thoroughly and uniformly compacted for the full thickness of the course to a minimum dry density of 95 percent of the maximum density. During compaction, water shall be applied to the surface as determined and ordered by the Engineer, to maintain the optimum moisture content.

**308-3.07 Finishing.** During the compaction operations, shaping will be required to obtain the required surface and cross-section. During shaping operations it may be necessary to lightly scarify and broom-drag the surface in order to remove ridges or depressions in excess of the permitted tolerance. The resulting surface shall then be rolled with a smooth steel wheel roller, weighing not less than 10 tons, or pneumatic tire rollers, or both. The final rolling shall be done by a smooth steel wheel roller. Several applications of water may be required to keep the surface at the proper moisture content, as ordered by the Engineer, during the finishing operation. Water shall be applied by the pressure spray bar method. Compaction and finishing shall be done in such a manner as to produce, in not longer than 2 1/2 hours after completion of mixing, a smooth, dense surface, free of surface compaction planes, cracks, ridges or loose material. Immediately after rolling, the surface of the course shall be tested for trueness, transversely and longitudinally. The finished surface of the course shall not extend above, nor be greater than 1/2 inch below, true grade and surface at any location. Surface finishing shall be completed in daylight hours.

Any portion of this course which has a density less than that specified shall be corrected or removed and replaced to its full depth to meet these specifications, at the Contractor's expense.

**308-3.08 Construction Joints.** At the end of each day's construction, a straight transverse and/or longitudinal construction joint shall be formed by cutting back into the completed work to form a true vertical face, which shall be properly maintained until the abutting section is completed.

**308-3.09 Curing and Surface Treatment.** After the soil cement course has been finished as specified herein, it shall be continually protected against drying by the application of water, until the bituminous seal is applied. At least 48 hours shall elapse between the completion of the finishing operations and the application of the bituminous seal.

At the time the bituminous seal is applied, the soil cement surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. Water shall be applied in sufficient quantity to fill the surface voids of the soil cement immediately before the bituminous seal is applied. The bituminous seal shall be uniformly applied to the surface of the completed soil cement at the rate of approximately 0.15 to 0.30 gal/sy with approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive run-off will be as determined and ordered by the Engineer. No traffic, nor placement of an overlying course, will be permitted over the soil cement course within 5 days from the application of the bituminous seal. Where this course is utilized for maintaining traffic, the application of the bituminous material shall be immediately followed by the application of approved cover aggregate of 1A size at the rate of 20 to 30 lb/sy. The aggregate will be broomed and rolled as ordered by the Engineer.

When the air temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil cement for 7 days after its construction and until it has hardened to the satisfaction of the Engineer.

**308-3.10 Traffic.** No traffic or hauling equipment other than that necessary for sealing, chipping or for placing the next course will be permitted over this course, unless specifically permitted by a Special Note in the Proposal.

**308-3.11 Maintenance.** The Contractor shall be required, within the limits of the contract, to maintain the soil cement in good condition and in a manner satisfactory to the Engineer from the time he first starts work until all work has been completed and accepted. Maintenance by the Contractor shall include immediate repairs of any defects, regardless of cause, that may occur. This work shall be done by the Contractor at its own expense, and repeated as often as may be necessary to keep the course continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the part repaired. Faulty and damaged work, regardless of cause, shall be replaced for the full depth of the course by the Contractor at its own expense. Any low areas, regardless of cause, shall be remedied by replacing the material for the full depth of the course and not by adding a thin layer of soil cement to the completed work.

**308-4 METHOD OF MEASUREMENT.** The quantity to be paid for under this item will be the number of cubic yards of material computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and completed in accordance with the plans and specifications. The thickness of the surface treatment will not be included in the volume measured for payment.

**308-5 BASIS OF PAYMENT.** The unit bid price per cubic yard for this item will include the cost of furnishing all labor, equipment and materials necessary to complete the work, except that furnishing Portland cement, calcium chloride (where required), bituminous material, water equipment and applying water, will be paid for separately under their respective items.

No direct payment will be made for any maintenance, repairs and replacements made before acceptance, nor for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage or any other causes: the cost of such will be included in the price bid for this item.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
308.01	Soil Cement Course	Cubic Yard

**SECTIONS 309 THRU 399 (VACANT)**

# Section 400

## HOT MIX ASPHALT

### SECTION 401 - PLANT PRODUCTION

(Last Revised January, 2020)

**401-1 DESCRIPTION.** The contractor is responsible for Quality Control (QC). QC is defined as all activities required to produce HMA that meets all specification requirements. The contractor shall incorporate a Quality Control system for all plant production of hot mix asphalt (HMA) and assume responsibilities for all QC activities at the production facilities.

The contractor shall produce the HMA according to the specifications herein and provide production documentation. Quality Adjustment Factors (QAFs) will be used to assess HMA production quality and these factors will be applied to calculate a quality payment adjustment.

The Department is responsible for Quality Assurance (QA). QA is defined as all activities performed by the Department to assure that HMA production meets the specification requirements. The Department will determine quality payment adjustments for each day's production using a daily QAF obtained from the calculations of the average absolute values for volumetric and non-volumetric mixes in accordance with Materials Procedure (MP) 401, *Quality Control and Quality Assurance Procedures for Quality Control Hot Mix Asphalt Production*. The daily QAFs measure production variation from the mean of the specification limits.

**401-2 MATERIALS.** The provisions of §402-2, *Materials*, apply and are as modified herein. Produce HMA in accordance with the requirements outlined in this specification, including all applicable Test Methods and Materials Procedures. HMA mixture designs must be accepted by the Department prior to any HMA production.

The Department reserves the right to suspend any mixture design when the mixture produces unacceptable paving results or exhibits properties that will affect the anticipated pavement performance.

**401-2.01 Hot Mix Asphalt Designs.** Formulate and submit a HMA design to the Regional Materials Engineer (RME) that satisfies all design criteria outlined in MM 5.16, *Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures*. When the submitted HMA design is assigned verification status, the design must be verified during production. Notify the RME at least 24 hours prior to the start of verification status production. When producing under verification status, make necessary adjustments to control the process. Apply daily QAFs to both verification and production status mix designs. Mixtures produced under verification status are allowed for use on State projects.

For any HMA permeable base and shim mixtures required by the contract documents, formulate and submit to the RME a job mix formula that satisfies the General Limits imposed by Table 401-1, *Composition of Hot Mix Asphalt Mixtures*.

**401-2.02 Aggregates.** Aggregate must be from a source approved by the Department. Use fine aggregate that consists of materials conforming to the requirements of §703-01, *Fine Aggregate*. In addition, fine aggregate may consist of screenings, free from deleterious materials and manufactured from sources of stone, gravel, or slag meeting the requirements of §703-02, *Coarse Aggregate*.

Use coarse aggregate that consists either of crushed stone, crushed gravel, or crushed slag conforming to the requirements of §703-02, *Coarse Aggregate* and MM 5.16.

Use slag aggregate on State projects only when an alternate pay item which takes the mix yield differential into account is included on the plans or in the itemized proposal.

When coarse aggregates for the mixture are from more than one source or of more than one type of material, proportion and blend them to provide a uniform mixture.

<b>TABLE 401-1 COMPOSITION OF HOT MIX ASPHALT MIXTURES</b>				
<b>Mixture Requirements</b>	<b>Permeable Base</b>		<b>Shim</b>	
	<b>Type 2</b>		<b>Type 5</b>	
<b>Screen Sizes</b>	<b>General Limits % Passing<sup>1</sup></b>	<b>Job Mix Tolerance %</b>	<b>General Limits % Passing<sup>1</sup></b>	<b>Job Mix Tolerance %</b>
2 in	100	---	---	---
1½ in	75 – 100	±7	---	---
1 in	55 – 80	±8	---	---
½ in	23 – 42	±7	---	---
¼ in	5 – 20	±6	100	---
1/8 in	2 – 15	±4	80 – 100	±6
No. 20	---	---	32 – 72	±7
No. 40	---	---	18 – 52	±7
No. 80	---	---	7 – 26	±4
No. 200	---	---	2 – 12	±2
Asphalt Content, % <sup>2,3</sup>	2.5 – 4.5	NA	7.0 – 9.5	NA
Mixing and Compaction Temperature Range °F	225 – 300		250 – 325	

**NOTES:**

1. All aggregate percentages are based on the total weight of the aggregates.
2. The asphalt content is based on the total weight of the mix. When using slag aggregates in the mix, the asphalt content shall be increased accordingly, a minimum of 25 percent for an all slag mix.
3. Use the PG binder listed in the proposal or as designated by the Regional Materials Engineer following the guidance specified in the Comprehensive Pavement Design Manual, Chapter 6, Section 6.2.5 – *Performance Graded Binder Selection*.

**A. Coarse Aggregate Type F1 Conditions.** Use one of the following types of coarse aggregate.

1. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonated materials.
2. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:
  - a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus 3/8 inch particles must be non-carbonate.
  - b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must

comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus No. 4 particles must be non-carbonate.

c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus No. 4 particles must be non-carbonate.

**B. Coarse Aggregate Type F2 Conditions.** Use one of the following types of coarse aggregate.

1. Limestone, dolomite, or a blend of the two having an acid-insoluble residue content of not less than 20.0%.

2. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.

3. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus 3/8 inch particles must be noncarbonate.

b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be noncarbonate.

c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be non-carbonate.

**C. Coarse Aggregate Type F3 Conditions.** Use one of the following types of coarse aggregate.

1. Limestone or a blend of limestone and dolomite having an acid-insoluble residue content of not less than 20.0%.

2. Dolomite.

3. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.

4. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus 3/8 inch particles must be noncarbonate.

b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be noncarbonate.

c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent

volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be non-carbonate.

**D. Coarse Aggregate Type F9 Conditions.** Use coarse aggregate meeting the requirements of §703-02, *Coarse Aggregate*.

**401-2.03 Mineral Filler.** Use mineral filler conforming to the requirements of §703-08, *Mineral Filler*.

**401-2.04 Performance-Graded Binder.** Use the Performance-Graded Binder (PG Binder) in the production of these mixtures that meets Section 702 – *Bituminous Materials*.

Initial acceptance of the PG Binder is based on the primary source appearing on the Department's Approved List for Bituminous Material Primary Sources, A. Performance-Graded Binders for Paving. Acceptance of the PG Binder is contingent upon satisfactory test results from samples taken, as required by the Department's procedural directives, at the location where the material is incorporated into the work. A primary source is defined as a firm that samples, tests, and certifies by Production Lot that the PG Binder is in conformance with the specifications. The procedural directives for sampling, testing, and certifying the PG Binder, and for achieving and maintaining approved list status, are available from the Materials Bureau.

The temperature of PG Binder delivered to the HMA Production Facility shall not exceed 350°F, unless the PG Binder supplier recommends it.

**401-2.05 Reclaimed Asphalt Pavement.** Reclaimed Asphalt Pavement (RAP) shall meet the requirements of MM 5.16.

### **401-3 CONSTRUCTION DETAILS.**

**401-3.01 Quality Control.** Perform all sampling and testing in accordance with Materials Procedure 401. Document all QC test results and records in a legible manner and provide them to the State at the end of each production season or when requested by the RME. HMA produced without the required sampling, testing and documentation may be rejected.

**401-3.02 Production Facility Laboratory.** Maintain an approved production facility site laboratory to perform all required HMA sampling and testing according to MP 401.

**401-3.03 Plant Lots and Sublots.** Determine plant lots and sublots on a daily basis in accordance with MP 401.

**401-3.04 Quality Control Sampling and Testing.** Obtain and test QC samples as outlined in MP 401.

**401-3.05 Production Control.** Produce HMA according to MP 401. Make necessary process control adjustments during production according to MP 401.

**401-3.06 Production Quantities.** Whenever production is made for the Department, notify the Regional Materials office by 3:00 p.m. the business day before the day of production.

Maintain a record of each day's production quantity for each mix design supplied to the project site daily. Retain these records at the production facility. These records must be available to the Department's representative for review. Ship all production quantities as outlined in §401-3.07 *Documentation*.

**401-3.07 Documentation.** Record all QC test data for each plant on the appropriate forms provided by the Department according to MP 401. Also, keep a copy of the plant automation printout at the plant



facility for each mix type produced and make them available for review at all times. Transmit a summary of all test data weekly to the RME.

Provide a delivery ticket indicating the total quantity in tons being delivered with each delivery vehicle supplying HMA. The method of determining the delivered quantity is subject to the approval of the RME. Make one legible copy of the delivery ticket available to the Department's paving inspector prior to the placement of the mixture showing the following minimum information:

- Ticket number
- Plant identification
- Contract number
- Site Manager Mix ID (as outlined in MP 401)
- Mix Code (as outlined in MP 401)
- Quantity of material in vehicle
- Date and Time

The quality assurance technician (QAT) will determine the quality adjustment factor (QAF) for each day's production in accordance with MP 401.

The Engineer will use the Daily QAF to calculate the payment adjustment for each day's production according to §402-4 *Method of Measurement*.

**401-3.08 HMA Mixing Plant.** HMA mixing plants must meet the requirements in MP 401.

**401-3.09 Hot Mix Asphalt Holding Bins.** HMA mixtures may be held in holding bins which meet the requirements in MP 401.

**401-3.10 Evaluation of Lots Represented by 0.85 QAF.** When any material results in a QAF of 0.85, the Engineer will evaluate the subject material to determine if it will be left in place. The Engineer may require the Contractor to core the pavement to determine if the in-place density is acceptable at no additional cost to the State. When cores are required, the Engineer will divide the pavement area being evaluated into 4 sublots in accordance with the requirements of §402-3.08, *Pavement Density Samples*. The material will be left in-place when either of the following sets of conditions is met.

- The calculated plant air voids used for payment are greater than 5.5% and less than or equal to 7.0%, the asphalt content, based on automation, is within 0.2% of the production target, the Contractor achieved field density of 92% to 97%, and there are no defects such as, but not limited to, cracking, raveling, rutting, shoving, or bleeding.
- The calculated plant air voids used for payment are greater than or equal to 1% and less than 1.5%, the validated QC and QA plant air void test results, according to MP 401, average 1.5% to 5.5%, the asphalt content, based on automation, is within 0.2% of the production target, the contractor achieved field density of 92% to 97%, and there are no defects such as, but not limited to, cracking, raveling, rutting, shoving, or bleeding.

If the material does not meet the above conditions or it is unknown, such as for mixes accepted based on gradation or if QA testing was not required, the Engineer will determine if the material in question may remain in-place considering, but not limited to, the following:

- Type of material produced
- The layer in which the material was placed
- The location and traffic volume
- Laboratory test results
- Field test results, such as density

If the subject material is left in-place, it will be assigned a QAF of 0.85. If determined the subject material will not be left in-place, the Contractor shall remove and replace the material at no additional cost to the State.

**401-4 METHOD OF MEASUREMENT.** The quantity will be the number of tons delivered as determined from the automated proportioning system, the delivery vehicle weigh system, or the HMA holding bin weigh system. The measurement or calculation will be the quantity based on the measured amount and reported to the nearest 0.01 of a ton.

## **SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS**

(Last Revised May, 2021)

**402-1 DESCRIPTION.** These specifications apply to all plant mixed Hot Mix Asphalt (HMA) produced at a production facility under Section 401 *Plant Production*, irrespective of aggregate gradation, type, and amount of HMA material or use.

This work will consist of providing, placing, and performing density monitoring of one or more courses of HMA pavement constructed on the prepared foundation in accordance with the contract documents or as directed by the Engineer.

### **402-2 MATERIALS**

**402-2.01 General.** Aggregate and Performance Graded (PG) Binder shall be from suppliers listed in the Department's Approved List for Fine and Coarse Aggregates and Performance Graded (PG) Binders for Hot Mix Asphalt (HMA) Paving, respectively. Mineral filler shall meet the requirements of §703-08.

A PG Binder grade and the Design Estimated Traffic in 80 kN ESALs will be specified by Special Note in the contract documents.

**402-2.02 Composition of Mixtures.** HMA mixture shall meet the requirements of §401-2 of the Standard Specifications and the mixture design procedure as written in Materials Method (MM) 5.16, *Hot Mix Asphalt Mixture (HMA) Design and Mixture Verification Procedures*.

The Contractor shall be responsible for the quality and performance of the mixture created from approved components.

**402-2.03 Warm Mix Technology.** The Contractor may elect to use Warm Mix Asphalt (WMA) technology in the production of Hot Mix Asphalt as a compaction aid at no additional cost to the State. The mixture shall meet the requirements of Section 404 Warm Mix Asphalt (WMA) Pavements of the Standard Specifications, except the mixing, delivery, and compaction temperatures shall meet the requirements of this Standard Specification.

The WMA technology shall appear on the Approved List for *Technologies for Warm Mix Asphalt*. The use of WMA shall comply with the latest technology supplier's "Production, Testing, and Compaction Details" from the Approved List.

### **402-3 CONSTRUCTION DETAILS.**

**Prepave Meeting.** The Engineer will conduct a prepave meeting prior to any asphalt mixture placement. The attendees at this meeting will include the Regional Materials Engineer, Paving Superintendent, Chief

Inspector or Paving Inspector(s), HMA Plant Representative, Density Gauge Operator, (depending on the compaction method used) and a Work Zone Traffic Control (WZTC) representative. The participants should be prepared to discuss the steps necessary to complete the work successfully.

Participants will review all aspects of the requirements including, but not limited to, the following:

- Asphalt mixture delivery temperature
- Equipment and setup
- Mix codes to assure correct mixture is delivered
- Gauge operator certification
- Proper construction practice to provide quality product
- WZTC Activities
- Anticipated mixture production, delivery rate, and paving speed.

**Certified Gauge Operator.** When a density gauge is used to monitor pavement density, the Contractor shall provide a certified operator with a current Density Gauge Inspector Certification from the Associated General Contractors (NY Chapter), or its equivalent, as determined by the Director of the Materials Bureau.

**402-3.01 Temperature and Seasonal Limitations.**

**A. Surface Temperature.**

**1. Surface Temperature.** Asphalt mixture shall be placed only when the pavement surface temperature is equal to or greater than those specified in Table 402-1 *Temperature Requirements*.

<b>TABLE 402-1 TEMPERATURE REQUIREMENTS</b>	
<b>Nominal Compacted Lift Thickness</b>	<b>Surface Temperature Minimum</b>
$\leq 1$ in	50°F
1 in < Thickness $\leq 3$ in	45°F
$> 3$ in	40°F

**2. Temperature Measurement.** The Contractor shall furnish a surface thermometer capable of reading surface temperature to the nearest 1°F for the exclusive use of the Engineer. The Engineer will measure pavement surface temperatures on the surface where the mixture is to be placed. The controlling temperature will be the average of three readings taken at locations 25 feet apart utilizing a surface thermometer covered by insulation for 10 minutes or until a constant temperature is reached.

**B. Seasonal Limits.** Top Course on mainline and shoulders shall be placed between April 1 and November 30 for the counties of Dutchess, Orange, Putnam, Rockland, Westchester, Nassau, Suffolk, and the City of New York. For all other counties, Top Course shall be placed between April 15 and October 31. When placing Top Course HMA outside the seasonal limitations, the Contractor shall provide a limited warranty against defects in such work. Performance of the warranty should be in accordance with Materials Procedure (MP) 402-01, *Warranty Requirements for Hot Mix Asphalt (HMA) Top Course*. Unless specified elsewhere in this specification or contract documents, these seasonal limits do not apply for any other HMA course placement.

**C. Temporary HMA Placements.** HMA mixture placement for temporary detours, which will not become part of the permanent pavement, are not subject to the temperature and seasonal limitations, but must be approved by the Engineer when placed outside temperature and seasonal limits. Any

damaged areas identified by the Engineer on the temporary HMA placements shall be repaired within one workday after the notification.

**D. Miscellaneous HMA Placements.** The Engineer may allow the placement of HMA mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction below the minimum temperature and outside the seasonal limits to expedite the completion of the work.

**E. Scheduling HMA Placement.** The Contractor shall schedule paving operations such that all HMA mixture placements are completed within the temperature and seasonal limitations. Should paving operations not be completed within temperature and seasonal limitations, the Contractor shall provide all temporary materials and work necessary such as shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work for adequate work zone traffic control. This shall be at no additional cost to the State.

When the approved schedule indicates that Base or Binder course, which will be permanently incorporated into the work, is to be left open to traffic over the winter, the Contractor shall apply joint adhesive to all the joints in accordance with Section 418 *Asphalt Pavement Joint Adhesive*.

When the anticipated top course is not placed within the seasonal limits as scheduled, the Contractor shall apply joint adhesive over the exposed joints in the Binder course at least 2 inches wide centered on the exposed joint at no additional cost to the State.

The Contractor shall repair damaged areas to the Base or Binder course left over the winter prior to placing subsequent course(s) at no additional cost to the State.

**402-3.02 HMA Pavers.** Paver shall be capable of spreading and finishing courses of HMA mixture in lane widths, shoulders, or similar construction applicable to the specified typical section and thicknesses shown on the plans. When a paver is found to be defective either before or during its use, it shall be repaired or replaced immediately. The paver shall meet the following requirements:

- Self-powered with an activated screed or strike-off assembly.
- Capable of operating at forward speeds consistent with satisfactory placement of the mixtures.
- Have a receiving hopper with enough capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed.
- Heat the screed or strike-off assembly as necessary to produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.
- When screed extensions are necessary for placement of mainline pavement, the extensions shall be of the same design as the main screed.
- The auger and tunnel extensions shall be mounted on the paver when the screed is extended more than 1 foot for fixed paving widths wider than 12 feet.
- When used for placing the initial paving course, Base, Binder, and Top Courses, the paver shall be equipped with automatic transverse slope and longitudinal grade screed controls that can be operated from either side of the paver. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. The controls shall also be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. The controls shall be capable of operating from suitable fixed or moving references as prescribed in §402-3.06 *Spreading and Finishing*. The transverse slope and longitudinal grade screed controls of the HMA paver may be manually adjusted according to the requirements of §402-3.06 *Spreading and Finishing*.

- Automatic screed controls are not required for shoulders, temporary detours, behind curbs, where existing grades at roadway intersection or drainage structure must be met, or in other areas where its use is impractical.

**402-3.03 Hauling Equipment.** HMA transport trucks shall have clean, smooth, tight metal beds with waterproof covers for transporting HMA mixtures to the work site. A waterproof cover shall be mounted in such a manner that it covers the entire load and overlaps the vehicle's sideboards and back by a minimum of 6 inches and is fastened except for live-bottom trucks that has channelized tarp system. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Approved List for Release Agents. The use of petroleum products or solvents as release agents is prohibited. All hauling equipment is subject to the approval of the Engineer.

**402-3.04 Rollers.** Contractor shall use vibratory, oscillatory, static steel wheel type, or pneumatic tire rollers capable of compacting HMA mixture and weighing at least 8 tons. The Engineer will inspect rollers prior to the start of paving operations to determine acceptability. The rollers should be in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. Rollers that result in excessive crushing of aggregate shall not be used.

All rollers shall have either a sticker or a plate installed on the roller indicating the recommended settings for amplitude, frequency, and tire pressure (pneumatic) for the thickness of pavement being rolled. Vibratory rollers shall be set up such that they produce a minimum of 12 impacts per foot during the compaction process.

**402-3.05 Conditioning of Existing Surface.** The Contractor shall use the provisions of Section 633 *Conditioning Existing Pavement Prior to Hot Mix Asphalt Overlay* to clean the surface of the existing pavement prior to the application of new asphalt mixture or when specified in the contract documents, to fill joints and cracks, and perform repairs. Any foreign material resulting from construction operations shall be cleaned at no additional cost to the State.

For filling the wheel ruts, the Contractor shall use Shim Course or 6.3 Top Course unless a specific asphalt mixture is specified. The mixture used for filling ruts shall be compacted with a minimum of three passes of a pneumatic rubber tire roller.

If the T&L course is specified in the contract documents using a specific mixture type, the Contractor shall place the course(s) with a minimum variable thickness to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. If the mixture type is not specified, the Contractor shall use Table 402-2 *Mixture Selection for T&L Course*, to select the appropriate mixture type.

The selection of the mixture shall be such that dragging of stones at the thin edge is minimized, including when constructing wedges for super-elevation. If dragging is excessive in any T&L course, a different T & L mixture shall be selected for the application. The surface of this course will be tested in the same manner prescribed in §402-3.10 *Surface Tolerance*, except that the allowable variation from the true surface after compaction shall not exceed  $\frac{3}{8}$  inch.

TABLE 402-2 MIXTURE SELECTION FOR T&L COURSE	
Compacted Thickness Range (in)	Mixture Type
Thickness $\leq$ 1	6.3 Top Course or Shim
1 < Thickness $\leq$ 2	9.5 or 12.5 Top Course
2 < Thickness $\leq$ 3	19.0 or 25.0 Binder Course
3 < Thickness $\leq$ 5	25.0 Binder Course or 37.5 Base Course

#### 402-3.06 Spreading and Finishing

**A. Tack Coat.** The Contractor shall apply tack coat, in accordance with Section 407 *Tack Coat*, between all HMA pavement lifts prior to placing HMA mixture regardless of time period between the lifts. Tack coat is not required on the surface of Permeable Base courses. Paving over a tack coat should not commence until the emulsion has broken (goes from brown to black) or is tacky when touched

**B. Joint Adhesive.** The Contractor shall apply joint adhesive in accordance with Section 418 *Asphalt Pavement Joint Adhesive* to all pavement joints butting against the new asphalt placement including curbs, median barriers or similar. The application of joint adhesive is for Top Course only unless it is specified for other courses in the contract documents or as required under §402-3.01E *Scheduling HMA Placement*.

**C. HMA Mixture Temperature.** HMA mixture temperature shall not exceed 325°F at the point of discharge of the haul vehicle, unless a higher temperature is approved by the Regional Materials Engineer.

**D. HMA Mixture from Multiple Plants.** HMA mixture from multiple plants shall not be supplied to a single paver.

**E. Reference Line.** The Contractor shall erect and maintain a taut reference line positioned at or near the pavement centerline or edge to guide the paver when the initial asphalt pavement course is laid for new or reconstructed pavement. The reference line shall be supported at approximately 25-foot intervals on tangent sections and at closer intervals on curves. The line shall be tensioned sufficiently to remove any sagging.

A moving reference of at least 30 feet can be used in lieu of a reference line with approval of the Engineer. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement course surface is even. A short ski or shoe may also be used for the initial course with the approval of the Engineer if a satisfactory fixed reference such as a curb, gutter, or other reference is adjacent to the pavement.

A short ski may be used over any course in an adjacent lane that is used as the reference. If the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, the use of the devices shall be discontinued, and a taut reference line shall be erected.

**F. HMA Mixture Placement.** The HMA paver shall be used to place the HMA mixture either over the entire width or over a partial width that is practical. The paver speed shall be coordinated with the rate of delivery of the mixture to provide a steady and continuous placement of the mixture without

interruption. The Contractor shall provide details of the anticipated mixture delivery rate and the anticipated paver speed at the prepave meeting.

The HMA mixture shall be placed on a clean, dry, tack-coated surface. If the areas to be paved are less than 1,000 square feet or small and scattered, the HMA mixture may be spread by hand or other method approved by the Engineer. For these areas, the mixture shall be dumped and spread such that the compacted thickness meets the thickness specifications located in the contract documents.

**G. Top Course Texture and Color.** The Top Course HMA mixture shall be supplied from a single plant for the duration of the work such that the pavement surface has a uniform color and texture, except when a contract includes multiple paving sites, or the paving length is more than 5 miles and supply from multiple plants to either end of the paving length is practical. In that case, the above requirement will apply to each paving site and locations at either end of the paving length as approved by the Engineer. Limits of each site will be subject to approval by the Engineer. If a plant breaks down, another plant may supply mixture if the aggregate used for producing the HMA mixture is from the same source, with the concurrence of the Engineer. When echelon paving is utilized, multiple plants may be used to supply mixture provided the aggregate used is from the same source. The provisions of §402-3.06 D *HMA Mixture from Multiple Plants* apply.

**H. Wet Surface.** Asphalt mixture shall not be placed on any wet surface. Wet surface is defined as one that is moistened, covered or soaked with water.

**402-3.07 Compaction.** The Contractor shall compact the HMA mixture sufficiently using the appropriate compaction method to achieve pavement densities of at least 93%, expressed as a percentage of the mixture's maximum theoretical density (MMTD).

The HMA mixture shall be compacted using rollers meeting the requirements of §402-3.04 *Rollers*. A minimum of two rollers, one for breakdown and one finish roller, shall be used unless the HMA mixture placement is on a bridge deck, bridge approaches, or other areas where one roller may be sufficient to achieve the required density. When paving multiple lanes simultaneously, the required number of rollers shall be increased proportionately for each additional full lane width unless otherwise approved by the Engineer. The HMA mixture shall be compacted immediately after placement, and when the mixture is in the proper condition such that the rollers do not cause displacement, cracking, or shoving. Initially, all courses shall be compacted with the roller traveling parallel to the centerline of the pavement, beginning at each edge and working toward the center. The super-elevated curves shall be compacted starting at the low-side edge and working toward the higher edge.

Any displacement caused by the roller, or any other causes, shall be corrected immediately using rakes and additional HMA mixture as required. The roller wheels shall be properly moistened with water, water mixed with small quantities of detergent, or other approved material, to prevent adhesion of the mixture to the rollers. The use of petroleum products or solvents are not allowed.

The HMA mixture along forms, curbs, headers, walls, and other areas not accessible to rollers shall be compacted with mechanical tampers, a trench roller, or a small vibratory roller with the approval of the Engineer.

The Contractor shall remove and replace any HMA mixture that becomes loose and broken, mixed with dirt, or is in any way defective and the new mixture shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of HMA material shall be corrected immediately.

Vibratory compaction is not allowed when HMA mixture is placed on structural bridge decks or other structures with less than 2 feet of cover over the structure or when specified in contract documents. The

Contractor shall repair all damages which may occur to the highway components and adjacent property, including buried utility and service facilities, at no additional cost to the State. Steel wheel rollers running on static mode, pneumatic rollers or oscillatory rollers shall be used on the bridge decks.

The Contractor shall monitor pavement density for 60 and 70 Series compaction using density gauges meeting the provisions of §402-3.07E *Density Gauges*. The density gauge operator shall possess a current Density Gauge Inspector Certification from The New York State Associated General Contractors, or its equivalent, as determined by the Director, Materials Bureau. Any HMA placement under 60 and 70 Series monitored by a gauge operator whose certification is revoked for reasons outlined in the New York State Inspector Certification Program Manual under “Decertification”, shall be evaluated in accordance with §402-3.14 *Pavement Evaluation*, using the results of pavement samples taken in accordance with §402-3.08 *Pavement Density Samples*.

**A. 50 Series Compaction Method.** All material placed on the traveled way and ramps which are 1500 feet or greater shall be subject to a pavement density Quality Adjustment Factor (QAF). A paving lot is defined as a day’s placement of at least 200 tons. Each paving lot shall be equally divided into sublots in accordance with Materials Procedure (MP) 402-02 *Hot Mix Asphalt (HMA) Pavement Density Determination*, based on the quantity placed. When the quantity placed is less than 200 tons in a day, pavement samples are not required and the density QAF for that day will be 1.00 provided the procedures used to obtain pavement densities in these areas are similar to the previously placed pavement sections. For quantity of more than 200 tons but less than or equal to 2000 tons in a day, the Engineer will divide the lot into 4 equal sublots. When the quantity exceeds 2000 tons, the Engineer will select one additional pavement core location for up to every 500 tons over 2000 tons, up to a maximum of 8 cores for a lot. Ramps less than 1500 feet and shoulders will not be considered part of the traveled way and are not subject to coring.

The Engineer will mark a pavement core location in each subplot in accordance with §402-3.08A *Pavement Cores* once the compaction operation is completed, excluding the first 300 feet of the day’s placement. The Contractor shall extract pavement cores at the marked locations in each subplot and fill the pavement core holes before the road is open to traffic in accordance with §402-3.08B *Filling Core Holes*. The pavement cores shall be extracted no later than the end of the following day’s placement. The Contractor shall deliver the sealed pavement cores to the Regional Materials Laboratory in accordance with §402-3.08 E *Sample Delivery*. The Regional Laboratory will test core samples and determine the percent density using the maximum theoretical density samples taken in accordance with §402-3.08 C *Loose Mix Samples*. The results of this analysis will be used to determine the pavement density Quality Adjustment Factor (QAF) in accordance with MP 402-02 and submitted to the Engineer prior to the end of the next business day upon the delivery of the samples. The Engineer will apply the pavement density QAF to the material placed on that day excluding the first 300 feet in accordance with §402.4 *Method of Measurement*, Table 402-6, *Quality Adjustment Factors for 50 Series*.

When two consecutive lots are found to have a density QAF equal to or less than 0.85, the Contractor shall stop paving operations and provide a corrective action plan.

The Contractor shall compact material on shoulders, widening, crossovers, bridges and ramps with a uniform full-width section of less than 1500 feet in length using the same roller pattern as traveled way. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows sign of distress during compaction, the compaction effort shall be decreased until no further damage occurs to the shoulder or subbase.

Multiple Paving Lots: When the work includes multiple paving operations such as echelon paving, each paving operation shall be considered a lot and evaluated separately. When the HMA is placed



continuously during a calendar day or more, a new paving lot will be defined when the paving crew shift change occurs

- B. 60 Series Compaction Method.** This method requires the Contractor to monitor pavement density using a density gauge and pavement cores. The Contractor shall construct the pavement to achieve a pavement density of at least 93% of the mixture's maximum theoretical density (MMTD).

**First day of Paving.** The Contractor shall construct the pavement using an interim PTD. The interim PTD will be 94.5% of the MMTD. The first 300 feet shall be used to adjust the paving operation. The Contractor shall take density readings at every 200 feet along the length of the pavement for each paver pass, in accordance with MP 402-02. The density gauge readings shall be recorded on the appropriate BR form based on the type of gauge used. The Contractor shall ensure the density gauge readings meet the PTD. If the density readings at two consecutive locations fall below 97% of the PTD or if the moving average of the last 10 density readings falls below 98% of the PTD, the Contractor shall adjust the PTD.

At the end of the first day's placement, or when the paving operation is stopped as mentioned above, the Engineer will randomly select and mark 4 pavement core locations in accordance with §402-3.08, excluding the first 300 feet.

The Contractor shall take density gauge readings, in accordance with MP 402-02 at each pavement core location prior to extracting the cores. The Contractor shall fill Form BR 109 with density gauge readings, gauge type, model, and the serial number.

The Contractor shall extract pavement cores at the marked location in each subplot and fill the core holes before the road is opened to traffic. The density gauge readings and sealed pavement cores shall be delivered to the Regional Materials Laboratory in accordance with §402-3.08 *Pavement Density Samples*.

The Regional Materials Laboratory will determine the percent density using representative samples taken in accordance with §402-3.08 *C Loose Mix Samples*. The results of this analysis will be used to determine the actual Project Target Density (PTD), and the pavement density Quality Adjustment Factor (QAF) and the results will be submitted to the Engineer prior to the end of the next business day following the delivery of the samples.

The Engineer will apply the pavement density QAF to the material placed on that day excluding the first 300 feet in accordance with §402-4 *Method of Measurement*, Table 8, Quality Adjustment Factors for 60 Series. When the quantity placed is less than 200 tons in a day, the density QAF for that day will be 1.00.

**Routine Paving:** The Contractor shall compact the pavement using the calculated PTD. If the calculated PTD differs from the previous PTD by more than 2 lbs/ft<sup>3</sup>, the Engineer will establish a new PTD. Density readings shall be taken every 200 feet along the length of the pavement for each paver pass, in accordance with MP 402-02. The density gauge readings shall be recorded on the appropriate BR form based on the type of gauge used. The minimum density reading shall be at least 97% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations. If density readings over two consecutive locations fall below 97% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, the Contractor shall stop routine paving operations. The Engineer will randomly select 4 cores over the entire day's paving. The

Contractor shall take density gauge reading at each location, fill out Form BR 109, extract the cores, and deliver to the Regional Laboratory.

**Coring Frequency:** The Engineer will select 4 core locations every third day of paving after the first day of paving, in accordance with MP 402-02, excluding the first 300 feet. On non-coring days, the Engineer will request pavement samples for density verification of HMA placed under the following situations at no additional cost to the State.

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving completed after the only density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.

The Contractor shall extract the cores and deliver them to the Regional Materials Laboratory for analysis in accordance with §402-3.08E. The Regional Materials Laboratory will determine the PTD and the pavement density QAF.

The Engineer will apply the QAF in accordance with §402-4 *Method of Measurement*, Table 8 to the material placed on that day excluding the first 300 feet.

Density on shoulders, ramps, widening and crossovers shall be monitored with the same density gauge to ensure the PTD is achieved. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that they show signs of distress, the Contractor shall decrease the compaction effort until no damage occurs to the shoulder or subbase.

**Multiple Paving Sites.** When the work includes multiple paving sites, each location shall be evaluated separately as described above.

- C. 70 Series Compaction Method.** The Contractor shall construct a test section in accordance with the provisions of *Test Section* below, prior to the placement of HMA mixture. The placement of HMA mixture, including the construction of the test section, shall not begin unless both a density gauge and a certified operator are present.

**Test Section.** On the first day of paving, the Contractor shall place and compact a test section on the mainline with a maximum of 1,500 linear feet in one lane to establish the Project Target Density (PTD) using the “peak” method. The location of the test section will be approved by the Engineer. The Contractor shall use the same equipment and procedures to be used in the construction of the remainder of the course. The first 300 feet of the test section shall be used to stabilize the paving operation. Initially, the mixture shall be compacted with a breakdown roller. The Engineer will select three random locations in accordance with MP 402-02 and mark these sites so that subsequent density testing can be performed at the same locations.

The Contractor shall make necessary vibratory and static passes to “peak” the pavement density such that the density gauge reading shall yield a density of at least 93% of the MMTD. The Contractor shall take density readings at the three selected sites after every additional machine pass until a “peak” density is achieved. A “peak” density is achieved when the increase in density is less than 2 lbs/ft<sup>3</sup> and it typically occurs when pavement is compacted at 175°F or less. The Contractor shall stop further compaction if the pavement shows signs of distress.

The PTD is the average of the highest density reading from each of the random locations. The calculated PTD shall be used to monitor the pavement density. The Engineer may request pavement cores to verify the PTD in accordance with MP 402-02.

The Contractor shall begin routine paving only after the PTD has been established. Density readings shall be taken every 200 feet along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with MP 402-02. The readings shall be recorded on the appropriate BR form based on the type of gauge used. The minimum density reading shall be at least 97% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations.

If density gauge readings over two consecutive locations fall below 97% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and construct a new test section.

Density on shoulders, ramps, widening and crossovers shall be monitored with the same density gauge to ensure the PTD is achieved. The appropriate BR form based on the gauge shall be used to record the density readings in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that they show signs of distress, the Contractor shall decrease the compaction effort until no damage occurs to the shoulder or subbase.

The Engineer may request pavement samples for density verification of HMA placed under the following situations at no additional cost to the State.

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving completed after the only density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.

**D. 80 Series Compaction Method.** The Contractor shall place and compact HMA mixture using roller passes required in Table 402-3, *Number of Machine Passes*. The number of passes listed in Table 402-3 may be increased or decreased by the Engineer to obtain adequate density.

The Contractor shall complete all breakdown roller passes before the mat temperature falls below 250°F.

Ruts, ridges, roller marks, or other irregularities from the surface shall be removed using static rolling. All the turning of the rollers shall be performed on material which has at least one roller pass to minimize damage. The Engineer may approve alternate compaction procedures for areas where the specified procedures are not applicable. Oscillatory rollers may be used for either rolling option.

<b>TABLE 402-3 NUMBER OF MACHINE PASSES<sup>12</sup></b>				
<b>Pavement Courses</b>	<b>Static Compaction<sup>3</sup></b>		<b>Vibratory Compaction</b>	
	<b>Steel Wheel Rollers</b>	<b>Pneumatic Rollers</b>	<b>Vibratory Passes</b>	<b>Static Passes</b>
≥3"	8	4	4	4
>1" to <3"	6	3	3	3
≤ 1"	4	2	2	2
Type 5 Shim	2	-	-	-
Permeable Base <sup>1</sup>	2	-	-	-

1. For the Permeable Base course, compact the mixture between 140°F and 230°F.

2. A vibratory pass is defined as one movement of a roller over the pavement with both drums vibrating. A static pass is defined as one movement of a roller over the pavement.
3. Where Static Compaction is required, an Oscillatory Roller used in oscillation mode may be used in lieu of a pneumatic roller.

**1. Static Compaction.** The Contractor shall compact the HMA mixture using a 3-roller train. The rollers shall make passes at a uniform speed not to exceed 3 mph. The HMA mixture shall be compacted with steel-wheel rollers operating in a static mode with each pass overlapping the previous roller pass by one-half the width of the roller followed immediately with a pneumatic rubber-tired roller.

A steel-wheel roller shall be used for finish rolling the HMA mixture to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

When the compaction procedure fails to produce acceptable results, the procedure shall be adjusted to obtain the desired results.

**2. Vibratory Compaction.** The Contractor shall compact the HMA mixture using a minimum of two rollers, one for breakdown and one finish roller, unless the HMA mixture placement is on a bridge deck, bridge approach, or other area where one roller may be sufficient to achieve the required density. When paving multiple lanes simultaneously, the required number of rollers shall be increased proportionally for each additional full lane width. The rollers shall make passes at a uniform speed to achieve a minimum of 12 impact per foot. The Contractor shall furnish a vibrating reed tachometer for the exclusive use of the Engineer. A vibrating reed tachometer shall have a frequency range of 1,000 vpm to 4,000 vpm with a minimum reed interval of 50 vpm between 1,000 vpm and 2,000 vpm and a minimum reed interval of 100 vpm between 2,000 vpm and 4,000 vpm.

The settings on the rollers shall be set to produce a minimum of 12 impacts per foot during the compaction process. Impacts are defined as the number of times a drum hits the pavement within one foot of travel. The Engineer will determine the impacts by using the following formula:

$$\text{Impacts per foot} = \frac{\text{VPM}}{\text{Speed}}$$

VPM = Frequency of the roller (vibration per minute)

Speed = Speed of the roller (feet per minute)

When satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, the use of the vibratory compaction method shall be ceased, and the remainder of the work shall be completed using static compaction methods in accordance with *1. Static Compaction*. This will be at no additional cost to the State.

If the number of roller passes are not being made or the roller setup does not provide the minimum impacts per foot consistently, the Contractor shall stop the paving operation and adjust the process as necessary to meet the requirements, and then restart the operation with the approval of the Engineer.

**E. Density Gauges.** The density gauges used for monitoring pavement density in accordance with MP 402-02 shall meet the following requirements:

**1. Nuclear Density Gauge.** A Safety Control plan shall be submitted at least two weeks prior to using the gauge. The nuclear density gauge shall meet the following requirements:

- Consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
- Calibrated at least every two years.
- Operated by personnel trained in the principles of nuclear testing and safety practices.

**2. Non-nuclear Density Gauge.** The non-nuclear density gauge shall meet the following requirements:

- Capable of functioning in the temperature and moisture levels experienced during HMA mixture paving.
- Capable of determining the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
- Calibrated at least every two years.

#### **402-3.08 Pavement Density Samples**

**A. Pavement Cores.** The Engineer will select pavement core locations randomly in accordance with MP 402-02 and outline a 10-inch diameter circle. The Contractor shall extract 6-inch diameter pavement cores from within the 10-inch diameter circles outlined by the Engineer. The Engineer will not designate pavement core locations before the rolling operation is completed and all compaction equipment has moved off the subplot designated for coring. The Contractor shall notify the Engineer immediately if a pavement core is in a location that is believed to not represent the subplot. If necessary, the pavement may be cooled so that the core samples are not damaged during coring. If the pavement core sample does not de-bond during coring, the Contractor shall not attempt to separate the core sample from the underlying layers. The Regional Materials Laboratory will separate the pavement core layer required for testing from the underlying material by sawing, if necessary.

1. Companion Cores - Taking companion cores in the testable area is not allowed.
2. Quality Control (QC) Cores - The Contractor may take up to 2 cores within the first 300 feet at the beginning of the first day's paving. Testing these cores shall be Contractor's responsibilities and the results can only be used for quality control (QC) purpose only. Any additional days of coring for QC must be approved by the Engineer.

**B. Filling Core Holes.** The Contractor shall fill the pavement core holes with a similar HMA mixture immediately after extracting the cores or before opening the lane to traffic. Any standing water in the core holes shall be removed prior to backfilling. The core hole shall be filled in layers of 3 inches or less and each layer must be sufficiently compacted. The use of a shovel or similar method to compact the HMA is not allowed.

**C. Loose Mix Samples.**

1. **50 Series** - The Contractor shall take two loose mix samples either at the plant or at the project site for each day of paving on the traveled way. The samples must represent each day's

placement. In addition, the Contractor shall provide the plant Quality Control Technician (QCT) and Quality Assurance Technician (QAT) mixtures maximum theoretical density (MMTD) results to the Regional Materials Engineer with the pavement core samples. The Department may take loose mix samples from the paver using MP 402-03 and use the results to supplement the daily MMTD when the QAT is not assigned at the plant.

2. **60 Series** - The Contractor shall provide the plant Quality Control Technician (QCT) and Quality Assurance Technician (QAT) MMTD results to the Regional Materials Engineer for each day of paving on the traveled way. The Department may take loose mix samples from the paver using MP 402-03 and the results used to supplement the daily MMTD when the QAT is not assigned at the plant.
3. **Joint Density** - The MMTD results representing the traveled way placement for 50 or 60 Series shall be used to determine percent density of the joint cores.

**D. Securing Pavement Cores.** The Engineer will secure and seal the pavement cores in accordance with MP 402-02 once they have been extracted from the pavement.

**E. Sample Delivery.** The Contractor shall deliver the pavement samples to the Regional Materials Laboratory no later than the end of the following day's placement. If these samples are not submitted for any paving lot within the required duration, a QAF of 1.00 or less will be assigned for that lot if a QAF is applicable. When, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, the Engineer will stop paving operations until the samples are delivered and tested.

**F. Unacceptable Pavement Cores.** The pavement cores will not be tested by the Department if they are damaged during extraction, or during transport to the Regional Materials Laboratory, or missing security seals. In that case, the Engineer will select new pavement core location(s) within a foot forward of the original location(s) at the same offset. The Contractor shall extract pavement cores from the newly identified location(s).

**G. Pavement Density Core Test Results.** Upon receipt of test results of the pavement cores provided by the Regional Materials Laboratory, the Contractor shall notify the Engineer within 2 working days if the results are not representative of the pavement density. The notification shall include details as to which specific test results are not representative, and the reasons for such notification.

**402-3.09 Joints.** The finished pavement at all joints shall comply with the surface tolerance requirements and exhibit the same uniformity of texture and compaction as other sections of the course. Rollers shall not pass over the unprotected edges of a freshly laid mixture unless approved by the Engineer.

All joints, excluding the tapered wedge joint, shall be constructed such that the exposed edge of the newly placed course is fully thick, and the course is straight unless the exposed joint will not be part of the joint. If the edge of the newly placed course is not straight or smoothly curved, the Contractor shall sawcut the edge by using a power saw or other approved tools to cut a neat straight line.

Prior to placing the adjacent course, a joint adhesive shall be applied in accordance with §402-3.06 *Joint Adhesive*, to all pavement edges in order to provide bonding with the newly laid pavement.

Successive HMA courses shall be placed over an underlying course such that all longitudinal joints are offset no more than 6 inches from the longitudinal joint of the lower pavement course, unless otherwise approved by the Engineer. HMA courses on existing PCC pavement shall be placed such that all longitudinal joints are stacked on top of the joint of the underlying PCC pavement.

**A. Transverse Joints.** The pavement courses shall be placed as continuously as possible to limit the number of transverse joints. The transverse joints in adjacent lanes shall be staggered at a minimum of 10 feet. The transverse joint shall be formed by cutting back the previous placement to expose the full depth of the course. The paver shall be set such that material laid overlaps the previously placed edge by 2 to 3 inches at a thickness of approximately 25% of the compacted thickness of the course. Broadcasting the overlapped material onto the fresh mat is not allowed. If the overlap is excessive, the extra material shall be trimmed uniformly along the joint. The coarse particles in the overlap material shall be removed and discarded, if necessary.

The transverse joint shall be compacted in static mode with the roller parallel to the joint and perpendicular to traffic. Boards of proper thickness shall be placed at the edge of the pavement for the off-pavement movement of the roller. The first pass shall be made with the roller operating on the previously laid material with 6 to 8 inches of its drum(s) overlapping onto the uncompacted HMA mixture. If a vibratory roller with pneumatic drive wheels is used, the first pass with one of the pneumatic wheels shall be aligned directly on the joint and the drum operating in static mode. The successive passes shall be made with the roller drum(s) moving approximately one foot onto the hot material per pass until half the width of the roller is on the hot mat.

**B. Longitudinal Joints.** The longitudinal joints in the Top Course shall correspond with the edges of the proposed traffic lanes. Other joint arrangements will require approval of the Engineer.

For 70 and 80 Series, the dual-drum vibratory roller shall be operated in a vibratory mode, unless static rolling is required, to construct the longitudinal joint. Rollers shall be as close to the paver as practical. The first pass shall be made traveling toward the paver and operating on the hot mat with 6 to 8 inches of the roller drum overlapping onto the cold mat. The second pass shall be made to the joint with the roller traveling back away from the paver along the same path.

If a single-drum vibratory roller with pneumatic drive wheels is used, the roller shall be operated in vibratory mode and following the same procedure. The exception to this is that the roller will be aligned on the joint so that the pneumatic drive wheels travel on the joint. All turning movements of the roller shall be made on previously compacted material. After applying two roller passes on the longitudinal joint, the roller shall proceed to the low side of the lane and compact as described in §402-3.07 *Compaction*.

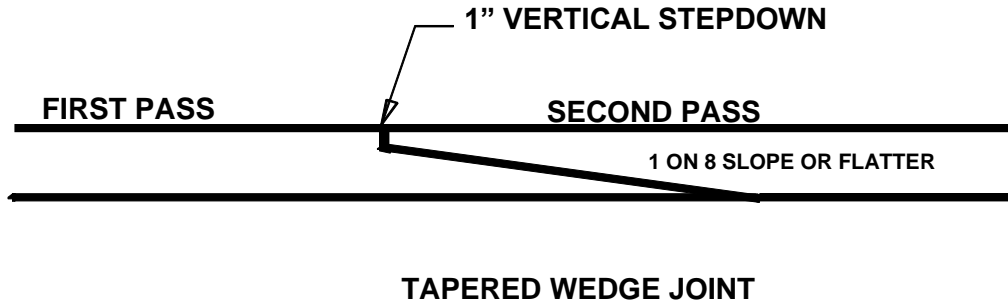
The longitudinal joint shall be constructed such that the compacted thickness of the newly placed mat shall not exceed  $\frac{1}{4}$  inch of the adjacent mat. When the joint is constructed with an overlap, the overlap shall not exceed 2 inches.

For all HMA courses other than Top Course, the longitudinal pavement joint shall not be exposed more than 100 feet at the end of the working day when traffic is maintained on the roadway during paving operations. For Top Course of 2 inches or less, refer to §402-3.09D *Exposed Longitudinal Joint*.

The longitudinal joint shall be constructed using one of the two options below:

- 1. Option A - Butt Joint.** This method shall be used for the placement of all pavement courses.
- 2. Option B - Tapered Wedge Joint.** This method shall be used for pavement thickness of 2 inches or less. The HMA mixture for the first pass shall be placed with an attachment to the paver to provide a sloping wedge with a vertical step-down of 1 inch at the longitudinal pavement joint. A wedge of material that is from the bottom of the step-down to the existing surface at a slope of 1

on 8 should be flatter. The vertical step-down shall be ½ inch minimum after compaction of the mat.



**C. Joint Density for 50 and 60 Series -**

Longitudinal joints in HMA top course between travel lanes for 50 and 60 Series compaction methods are subject to a performance measure based on the core density testing. The Contractor shall select the joint construction method to provide optimum density at the joint.



The cores will be taken from the total length of the joint matched daily. The number of cores extracted shall be in accordance with Table 402-4 *Longitudinal Joint Cores for 50 & 60 Series*. The Engineer will randomly mark core locations centered over the constructed joint in accordance with MP 402-02 using the X coordinates only. A matched joint of 1500 feet or less is not subject to coring. The Contractor shall extract cores on the same day the joint is matched or before the completion of next day’s placement. The cores shall be extracted in accordance with §402-3.08A *Pavement Density Samples* and delivered to the Regional Laboratory. The Regional Materials Engineer will determine the core density using the mixture’s maximum theoretical density specified in §402-3.08C.

TABLE 402-4 LONGITUDINAL JOINT CORES FOR 50 & 60 SERIES	
Daily Joint Length (feet)	No. of Cores
1,500 < Length ≤ 10,000	4
10,000 < Length ≤ 20,000	6
Length > 20,000	8

**D. Exposed Longitudinal Joint.** The exposure of longitudinal joints is not allowed over the weekends, holidays, or when there are other concerns, such as pending wet weather. The joint for the



Top Courses with a thickness of 2 inches or less may be exposed to traffic for no more than 24 hours with the following conditions:

- Tapered wedge joint shall be used for 12.5 HMA and 9.5 HMA and a butt joint shall be used for 6.3 HMA.
- The warning signs shall be posted in advance of the condition, at each ramp, and roadway intersection, and repeated every ½ mile in accordance with §619-3.02 **Basic Work Zone Traffic Control**.
- If the exposed longitudinal pavement joint becomes damaged due to rounding of the notched wedge, the joint shall be saw-cut prior to placing the adjacent lane.
- Joint adhesive shall be applied to the exposed joint prior to placement of the adjacent lane in accordance with §402-3.06 *Joint Adhesive*.

**402-3.10 Surface Tolerance.** The Contractor shall construct each pavement course to a ¼ inch surface tolerance. The Engineer may test the surface with a 16-foot straight edge or string line placed parallel to the centerline of the pavement and with a 10-foot straight edge or string line placed transversely to the centerline of the pavement. Variations exceeding ¼ inch shall be appropriately corrected or the pavement be removed and replaced at no additional cost to the State.

**402-3.11 Thickness Tolerance.** The Contractor shall construct the pavement such that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below. The thickness indicated for each of the various courses of HMA pavement is the nominal thickness.

The Engineer may request pavement cores to determine the thickness of the completed pavement course for final acceptance and payment. The Contractor shall provide work zone traffic control and take pavement cores in accordance with §402-3.08 *Pavement Density Sample*, at no additional cost to the State. The Engineer may use another acceptance method such as yield calculations to determine the final thickness for acceptance and payment.

HMA mixture placed as a Truing and Leveling course as described in §402-3.05 *Conditioning of Existing Surface* shall not be considered in pavement thickness determinations. The allowable tolerance for HMA mixture specified under a single pay item is as follows:

- 1/4 inch or less for a required course whose nominal thickness is 4 inches or less.
- 1/2 inch or less for a course or courses whose nominal thickness is over 4 inches.

The tolerance for the total thickness of all HMA mixture courses shall be 1/4 inch. When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of 1/4 inch will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness. No payment shall be made for any material placed in excess of the permissible tolerance.

**402-3.12 Paver and Equipment Cleaning.** Tools and equipment used for HMA placement shall not be cleaned on the pavement surface, or near streams, ponds, drainage structures or other areas that are tributaries to waterways. The designated area approved by the Engineer shall be used for cleaning all paving equipment and tools. If a petroleum product is used for cleaning, tarpaulins, sand pads, pails, or other collection methods of all liquid products during cleaning operations shall be used to prevent spillage or accidental release. Hand sprayers or other similar devices may be used to minimize the amount of petroleum product applied. The sand and the collected petroleum products shall be properly disposed of as petroleum contaminated soil at no additional cost to the State.

**402-3.13 Shoulder Edge Wedge.** When specified, the Contractor shall construct a shoulder edge wedge as detailed in the contract documents. The HMA mixture shall be placed on the pavement shoulders where the outside edge of Top and Binder Course consist of an angle of 35° or flatter measured from finished grade to the preceding course surface. The shoulder edge wedge shall be constructed using a device attached to the screed to minimize hand work. The top of the tapered section shall be at the end of the shoulder width such that the tapered section will be an additional width of material outside of the paved shoulder width. The shoulder edge wedge is optional at locations where guiderails are installed.

**402-3.14 Pavement Evaluation.** The Engineer will evaluate mixtures either placed or produced outside the specification limits which results in low quality adjustment factors.

**A. Plant Production.** When plant production QAF is 0.85, the Engineer will evaluate the pavement section in accordance with §401-3.10 *Evaluation of Sublots Represented by 0.85 QAF* to decide whether to keep it in place or not.

**B. Pavement Density.** When a QAF of a paving lot for 50 Series, 60 Series or 70 Series compaction method is calculated to be 0.60, the Engineer will evaluate the lot to determine if it can be left in place. The type of material produced (i.e. Binder, Top), the course in which it is used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA mixture can be left in place. If it is determined that the HMA mixture can be left in place, the Engineer will apply a QAF of 0.60. If the HMA mixture cannot be left in place, the Engineer will instruct the Contractor to remove and replace the mixture at no additional cost to the State.

**402-3.15 Pavement Defects.** Upon completion of the HMA mixture placement, the Engineer will ensure there are no visible defects in the pavement, such as ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other irregularities. The Contractor shall correct any defects that become apparent or replace the defective pavement at no additional cost to the State.

#### **402-4 METHOD OF MEASUREMENT**

**402-4.01 Hot Mix Asphalt.** The quantity of HMA mixture to be measured for payment will be measured in tons and rounded to the nearest 0.01 tons.

**402-4.02 Plant Production Quality Adjustment.** Plant Production Quality Adjustments will be measured in Quality Units determined for each day's production using the daily Quality Adjustment Factor (QAF) for plant production. Also, this will be determined in accordance with §401-3.07 *Documentation*. Quality Units for plant production quality adjustments will be calculated using the formula below.

$$\text{Quality Units} = (\text{Quality Adjustment Factor} - 1.00) \times \text{HMA Placed (Tons)}$$

No plant adjustment will be made for temporary pavement, shim, permeable base items and other miscellaneous items.

**402-4.03 Pavement Density Quality Adjustment.** Pavement Density Quality Adjustments will be measured in Quality Units determined for each day's production using the daily Quality Adjustment Factor (QAF) for pavement density. The quantity of HMA mixture subject to adjustment will be determined from quantity placed on the mainline. The pavement density QAF will not apply to HMA mixture placed on ramps with a uniform full width section less than 1500 feet, shoulders, widening, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction. When shoulders and mainline are placed together, the mainline quantity may be determined using typical sections shown in the contract documents.

Quality Units for pavement density quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No pavement density quality adjustments will be made under 70 and 80 Series compaction methods.

$$\text{Quality Units} = (\text{Quality Adjustment Factor} - 1.00) \times \text{HMA Placed (Tons)}$$

**A. 50 Series Compaction QAF.** The Engineer will determine the Percent Within Limits (PWL) for a paving lot in accordance with MP 402-02 and determine the QAF in accordance with Table 402-6 *Quality Adjustment Factors for 50 Series* and use the QAF to calculate the Quality Units for the accepted HMA mixture quantity. A payment adjustment will be made using the Quality Unit Index Price to all the material placed on the traveled way for the day the pavement cores represent.

TABLE 402-6 QUALITY ADJUSTMENT FACTORS FOR 50 SERIES	
Percent Within Limits (PWL)	Quality Adjustment Factor (QAF)
$PWL_{\geq 93} > 93$	1.05
$PWL_{\geq 93} \leq 93$	$\sum (PWL_{\text{Segment}} \times \text{Pay Factor}_{\text{Segment}})^1$

1.  $PWL_{\text{Segment}}$  will be calculated for each of the density ranges in Table 402-7 *Density Segment Pay Factors*, using the standard deviation and average density for the lot.

TABLE 402-7 DENSITY SEGMENT PAY FACTORS	
Density Segment	Segment Pay Factor
88 – 90	0.60
90 – 91	0.70
91 – 92	0.80
92 – 93	0.90
93 – 94	1.00
94 – 100	1.05

**B. 60 Series Compaction QAF.** The Engineer will determine QAF in accordance with Table 402-8 *Quality Adjustment Factors for 60 Series* and use the QAF to calculate the Quality Units for the accepted HMA mixture quantity. A payment adjustment will be made using the Quality Unit Index Price to all the material placed on the traveled way for the day the pavement cores represent.

TABLE 402-8 QUALITY ADJUSTMENT FACTORS FOR 60 SERIES	
Average Pavement Core Density	Quality Adjustment Factor
$\text{Density} \geq 93.0$	1.00
$88.0 \leq \text{Density} < 93.0$	$\text{QAF} = 0.08 * \text{Avg Core Density} - 6.44^1$
$\text{Density} < 88.0$	0.60

1. Quality Adjustment Factor rounded to two decimal places using ASTM standard.

**402-4.04 Joint Density Quality Adjustment.** The Engineer will determine the density of each joint core and calculate the average percent of the mixture's maximum theoretical density (%MMTD) of the longitudinal joint cores. The Engineer will measure the length of longitudinal joints, in linear feet, and determine the number of segments. A segment is defined as a 528-foot section of a joint. A partial segment of 264 feet or greater ( $\geq 0.5$  of a segment) will be considered a full segment.

The Engineer will determine the segment Quality Units (QU) from Table 402-9 *Quality Adjustment for Longitudinal Joint Density* based on the average density of the joint cores and calculate the total Quality Units using the formula below.

$$\text{Quality Units} = \text{Segment QUs} \times \# \text{ of Segments}$$

A payment adjustment will be made using the Quality Unit Index Price to the longitudinal joint length on the traveled way for the day the joint cores represent.

TABLE 402-9 QUALITY ADJUSTMENT FOR LONGITUDINAL JOINT DENSITY	
Average Core Density, % MMTD	Segment Quality Units (QU)
Density $\geq$ 93.0	4
86.0 $\leq$ Density < 93.0	QU = 1.143 * Avg Core Density - 102.3 <sup>1</sup>
Density < 86	-4

1. Quality Unit rounded to a whole number using ASTM standard.

**402-5 BASIS OF PAYMENT.** The unit price bid for all HMA mixture shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including cleaning of pavement, extracting the pavement cores, filling, and compaction of all core holes. Application of tack coat, joint adhesive, and repairs of pavement, and filling of cracks will be paid separately except when the joint adhesive is applied under §402-3.01E.

Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed index price for Quality Adjustment to HMA Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

**Payment will be made under:**

Item No.	Item	Pay Unit
402.011904	Type 2 F9, Asphalt-Treated Permeable Base Course	Ton
402.017904	Truing & Leveling F9, HMA, 70 Series Compaction	Ton
402.018904	Truing & Leveling F9, HMA, 80 Series Compaction	Ton
402.058904	Shim Course F9, HMA	Ton
402.068104	6.3 F1 Top Course HMA, 80 Series Compaction	Ton
402.068204	6.3 F2 Top Course HMA, 80 Series Compaction	Ton
402.068304	6.3 F3 Top Course HMA, 80 Series Compaction	Ton
402.095104	9.5 F1 Top Course HMA, 50 Series Compaction	Ton
402.095204	9.5 F2 Top Course HMA, 50 Series Compaction	Ton
402.096104	9.5 F1 Top Course HMA, 60 Series Compaction	Ton
402.096204	9.5 F2 Top Course HMA, 60 Series Compaction	Ton
402.096304	9.5 F3 Top Course HMA, 60 Series Compaction	Ton
402.097104	9.5 F1 Top Course HMA, 70 Series Compaction	Ton
402.097204	9.5 F2 Top Course HMA, 70 Series Compaction	Ton
402.097304	9.5 F3 Top Course HMA, 70 Series Compaction	Ton
402.098104	9.5 F1 Top Course HMA, 80 Series Compaction	Ton
402.098204	9.5 F2 Top Course HMA, 80 Series Compaction	Ton
402.098304	9.5 F3 Top Course HMA, 80 Series Compaction	Ton
402.098904	9.5 F9 T&L or Shoulder Course HMA, 80 Series Compaction	Ton
402.125104	12.5 F1 Top Course HMA, 50 Series Compaction	Ton
402.125204	12.5 F2 Top Course HMA, 50 Series Compaction	Ton

402.126104	12.5 F1 Top Course HMA, 60 Series Compaction	Ton
402.126204	12.5 F2 Top Course HMA, 60 Series Compaction	Ton
402.126304	12.5 F3 Top Course HMA, 60 Series Compaction	Ton
402.127104	12.5 F1 Top Course HMA, 70 Series Compaction	Ton
402.127204	12.5 F2 Top Course HMA, 70 Series Compaction	Ton
402.127304	12.5 F3 Top Course HMA, 70 Series Compaction	Ton
402.128104	12.5 F1 Top Course HMA, 80 Series Compaction	Ton
402.128204	12.5 F2 Top Course HMA, 80 Series Compaction	Ton
402.128304	12.5 F3 Top Course HMA, 80 Series Compaction	Ton
402.128904	12.5 F9 T&L or Shoulder Course HMA, 80 Series Compaction	Ton
402.195904	19 F9 Binder Course HMA, 50 Series Compaction	Ton
402.196904	19 F9 Binder Course HMA, 60 Series Compaction	Ton
402.197904	19 F9 Binder Course HMA, 70 Series Compaction	Ton
402.198904	19 F9 Binder Course HMA, 80 Series Compaction	Ton
402.255904	25 F9 Binder Course HMA, 50 Series Compaction	Ton
402.256904	25 F9 Binder Course HMA, 60 Series Compaction	Ton
402.257904	25 F9 Binder Course HMA, 70 Series Compaction	Ton
402.258904	25 F9 Binder Course HMA, 80 Series Compaction	Ton
402.376904	37.5 F9 Base Course HMA, 60 Series Compaction	Ton
402.377904	37.5 F9 Base Course HMA, 70 Series Compaction	Ton
402.378904	37.5 F9 Base Course HMA, 80 Series Compaction	Ton
402.418904	9.5 F9 Temporary Top Course HMA, 80 Series Compaction	Ton
402.428904	12.5 F9 Temporary Top Course HMA, 80 Series Compaction	Ton
402.438904	19 F9 Temporary Binder Course HMA, 80 Series Compaction	Ton
402.448904	25 F9 Temporary Binder Course HMA, 80 Series Compaction	Ton
402.000014	Plant Production Quality Adjustment to HMA Items	Quality Unit
402.000024	Pavement Density Quality Adjustment to HMA Items	Quality Unit
402.000034	Longitudinal Joint Density Quality Adjustment to HMA Items	Quality Unit

## **SECTION 403- HOT MIX ASPHALT (HMA) WITH POLYMER FIBERS**

**403-1 DESCRIPTION.** The work shall include the production and placement of hot mix asphalt with polymer fibers.

**403-2 MATERIALS.** Material requirements shall be as specified in the special specifications.

**403-3 CONSTRUCTION DETAILS.** The construction requirements shall be as specified in the special specifications.

**403-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**403-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 404 - WARM MIX ASPHALT (WMA) PAVEMENTS**

**404-1 DESCRIPTION.** These specifications apply to all plant mixed Warm Mix Asphalt (WMA) produced at a production facility under Section 401 *Plant Production*, irrespective of aggregate gradation, type, and amount of WMA material or use. WMA is standard HMA produced using a WMA technology that can result in production mixture temperatures of 295°F or lower.

This work will consist of providing, placing, and performing density monitoring of one or more courses of WMA pavement constructed on the prepared foundation in accordance with the contract documents or as directed by the Engineer.

The words “hot mix asphalt” and “HMA” in the Standard Specifications and other documents referenced by this specification shall apply to WMA.

**404-2 – MATERIALS.** Requirements of §401-2 and §402-2 shall apply except as noted herein.

- 1. WMA Technology.** The Contractor shall use a WMA technology appearing on the State’s Approved List for Warm Mix Asphalt Technologies.
- 2. WMA Design.** A mixture using a WMA Technology shall be designed in accordance with MM 5.16, *Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedure*.

**404-3 CONSTRUCTION DETAILS.** Requirements of §401-3 and §402-3 shall apply except as noted herein.

**Mix Temperature.** The desired WMA mixture temperature shall be within the mixing and compaction range as recommended by the WMA technology provider not to exceed 295°F at the point of discharge of the haul vehicle, unless a higher temperature is approved by the Regional Materials Engineer.

For 80 Series compaction method, all breakdown roller passes shall be completed before the mat temperature falls below 230°F.

**404-4 METHOD OF MEASUREMENT.** Requirements of §401-4 and §402-4 shall apply.

**404-5 BASIS OF PAYMENT.** The unit price bid for WMA mixtures shall meet the requirements specified in §402-5 Basis of Payment

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
404.011901	Type 2 F9, WMA Asphalt-Treated Permeable Base Course	Ton
404.017901	True & Leveling F9, WMA, 70 Series Compaction	Ton
404.018901	True & Leveling F9, WMA, 80 Series Compaction	Ton
404.058901	Shim Course F9, Warm Mix Asphalt	Ton
404.068101	6.3 F1 Top Course WMA, 80 Series Compaction	Ton
404.068201	6.3 F2 Top Course WMA, 80 Series Compaction	Ton
404.068301	6.3 F3 Top Course WMA, 80 Series Compaction	Ton
404.095101	9.5 F1 Top Course WMA, 50 Series Compaction	Ton
404.095201	9.5 F2 Top Course WMA, 50 Series Compaction	Ton
404.096101	9.5 F1 Top Course WMA, 60 Series Compaction	Ton
404.096201	9.5 F2 Top Course WMA, 60 Series Compaction	Ton
404.096301	9.5 F3 Top Course WMA, 60 Series Compaction	Ton
404.097101	9.5 F1 Top Course WMA, 70 Series Compaction	Ton
404.097201	9.5 F2 Top Course WMA, 70 Series Compaction	Ton
404.097301	9.5 F3 Top Course WMA, 70 Series Compaction	Ton
404.098101	9.5 F1 Top Course WMA, 80 Series Compaction	Ton
404.098201	9.5 F2 Top Course WMA, 80 Series Compaction	Ton
404.098301	9.5 F3 Top Course WMA, 80 Series Compaction	Ton
404.098901	9.5 F9 T&L or Shoulder Course WMA, 80 Series Compaction	Ton
404.125101	12.5 F1 Top Course WMA, 50 Series Compaction	Ton

404.125201	12.5 F2 Top Course WMA, 50 Series Compaction	Ton
404.126101	12.5 F1 Top Course WMA, 60 Series Compaction	Ton
404.126201	12.5 F2 Top Course WMA, 60 Series Compaction	Ton
404.126301	12.5 F3 Top Course WMA, 60 Series Compaction	Ton
404.127101	12.5 F1 Top Course WMA, 70 Series Compaction	Ton
404.127201	12.5 F2 Top Course WMA, 70 Series Compaction	Ton
404.127301	12.5 F3 Top Course WMA, 70 Series Compaction	Ton
404.128101	12.5 F1 Top Course WMA, 80 Series Compaction	Ton
404.128201	12.5 F2 Top Course WMA, 80 Series Compaction	Ton
404.128301	12.5 F3 Top Course WMA, 80 Series Compaction	Ton
404.128901	12.5 F9 T&L or Shoulder Course WMA, 80 Series Compaction	Ton
404.195901	19 F9 Binder Course WMA, 50 Series Compaction	Ton
404.196901	19 F9 Binder Course WMA, 60 Series Compaction	Ton
404.197901	19 F9 Binder Course WMA, 70 Series Compaction	Ton
404.198901	19 F9 Binder Course WMA, 80 Series Compaction	Ton
404.255901	25 F9 Binder Course WMA, 50 Series Compaction	Ton
404.256901	25 F9 Binder Course WMA, 60 Series Compaction	Ton
404.257901	25 F9 Binder Course WMA, 70 Series Compaction	Ton
404.258901	25 F9 Binder Course WMA, 80 Series Compaction	Ton
404.376901	37.5 F9 Base Course WMA, 60 Series Compaction	Ton
404.377901	37.5 F9 Base Course WMA, 70 Series Compaction	Ton
404.378901	37.5 F9 Base Course WMA, 80 Series Compaction	Ton
404.418901	9.5 F9 Temporary Top Course WMA, 80 Series Compaction	Ton
404.428901	12.5 F9 Temporary Top Course WMA, 80 Series Compaction	Ton
404.438901	19 F9 Temporary Binder Course WMA, 80 Series Compaction	Ton
404.448901	25 F9 Temporary Binder Course WMA, 80 Series Compaction	Ton
404.000011	Plant Production Quality Adjustment to WMA Items	Quality Unit
404.000021	Pavement Density Quality Adjustment to WMA Items	Quality Unit
404.000031	Joint Density Quality Adjustment to WMA Items	Quality Unit

## **SECTION 405 - COLD MIX BITUMINOUS PAVEMENT (OPEN GRADED)**

**405-1 DESCRIPTION.** This work shall consist of constructing one or more courses of cold mix bituminous pavement on a prepared base in accordance with these specifications and in substantial conformance with the lines, grades, thicknesses, and typical cross-sections shown on the plans or established by the Engineer.

### **405-2 MATERIALS**

**405-2.01 Bituminous Material.** The bituminous materials required for mixing and for sealing shall meet the requirements of section 702, Bituminous Materials. The type and grade of bituminous material shall be that indicated on the plans or in the proposal.

**405-2.02 Aggregates.** The aggregates shall be Department approved aggregates meeting the requirements of § 703-02, Coarse Aggregates, for the sizes specified. Screened gravel shall not be permitted unless specified on the plans or in the proposal.

**405-2.03 Composition of Mixtures.** The bituminous cold mix shall be composed of a mixture of aggregate and bituminous material as ordered and approved by the Engineer. The mix shall be proportioned as specified in Table 405-1, Composition of Cold Bituminous Mixtures.

<b>TABLE 405-1 COMPOSITION OF COLD BITUMINOUS MIXTURES</b>			
<b>Sieve Size</b>	<b>Mixes</b>		
	<b>Type 1 General Limits % passing<sup>1</sup></b>	<b>Type 2 General Limits % passing<sup>1</sup></b>	<b>Type 3 General Limits % passing<sup>1</sup></b>
2 in	-	-	100
1 1/2 in	-	100	75-100
1 in	100	90-100	50-80
1/2 in	90-100	15-45	0-15
1/4 in	15-45	0-10	-
1/8 in	0-10	-	-
No. 200	0-1.0	0-1.0	0-1.0
Bituminous Material <sup>2,3</sup>	4.7-7.0	4.0-6.0	3.5-5.5
Description	Open, Coarse Texture	Open, Coarse Texture	Open, Coarse Texture
Typical Uses	Surface Course	Intermediate	Base Course

1 Percentage based on total aggregate weight.

2. Total Emulsion Percentage based on total mix weight.

3 When crushed air-cooled blast furnace slag aggregate is selected, the above bituminous material content shall be increased approximately 25%.

### **405-3 CONSTRUCTION REQUIREMENTS**

**405-3.01 Weather Limitations.** Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F, or when other weather conditions would prevent proper construction of the pavement.

**405-3.02 Equipment.** The following equipment shall be required:

- Either central pugmill mixer and bituminous paver or Travel plant mixer
- Bituminous material distributor
- Steel wheeled roller, 8-12 Ton or Approved vibratory roller
- Chip spreader
- Power broom
- Motor grader, if required
- Miscellaneous equipment to perform the work

All equipment and the condition of the equipment for this work shall be subject to approval of the Engineer at all times.

Mixing shall be done with a rotating twin paddle shaft pugmill providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either by the travel mix plant method or in a central pugmill mixer.

The mixer shall be either a continuous traveling type, central continuous or batch type pugmill designed to accurately proportion wither by volume or by weight, so that when the aggregate and



bituminous materials are incorporated in the mix, a thorough and uniform coating will result. The mixer shall be equipped to mechanically or electrically interlock the bituminous feed with the aggregate feed such that uniformity of the mixture is assured at all times. The pugmill mixer, either traveling or central type, shall be provided with weighing, volumetric or other gauging equipment which shall be capable of providing accurate control at all times of the amount of aggregate entering the mixer per time interval. On the central continuous type pugmill a mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. The mixer shall be equipped with a positive displacement metering system capable of totalizing the quantity of bituminous material applied to the mixing chamber.

**405-3.03 Preparation of the Base.** The roadway surface to be covered shall be free from holes, depressions, bumps, waves and corrugations. Any unsuitable surface areas shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the same elevation as the surrounding surface. The roadway surface shall be broomed when ordered by the Engineer to remove loose material.

**405-3.04 Mixing and Spreading.** The aggregate and asphalt shall be thoroughly mixed so that the bituminous material is uniformly distributed throughout and all aggregate particles are uniformly coated.

The mixture shall be deposited on the prepared base either in a windrow at the back of the travel mixer or mechanically spread in a uniform layer so as to produce the specified thickness after compaction. If deposited in a windrow, it shall be spread over the entire roadway surface by motor grader or other approved spreader to produce the specified thickness after compaction. The maximum allowable compacted thickness shall be 2 inches for the Type 1 mix (Table 405-1) and 4 inches for the Type 2 and Type 3 mixes (Table 405-1).

**405-3.05 Compaction.** After spreading, the mixture shall be thoroughly and uniformly compacted with a self-propelled steel-wheeled roller or an approved vibratory roller to obtain a thoroughly compacted pavement. The number of roller passes to achieve the desired compaction shall be approved by the Engineer.

**405-3.06 Surface Testing.** The finished surface of the pavement shall be tested with a 16 foot straight edge laid parallel with the center line of the pavement. Any area exceeding a 1/4 inch variation from the surrounding area shall be satisfactorily corrected or removed and replaced.

**405-3.07 Pavement Sealing.** Either prior to initial compaction or immediately after compacting the mix, No. 1A size key stone meeting the requirements of § 703-02, Coarse Aggregates, shall be uniformly spread upon the surface at the rate of 10 to 15 lb/sy and the course rolled. No. 1 size key stone meeting the requirements of § 703-02, Coarse Aggregates, at the rate of 10 to 20 lb/sy, may be used for key stone on the base course mixes. After placement of the No. 1A size key stone, the pavement shall be opened to traffic for a minimum of 3 days before placing the seal coat.

Prior to the application of the seal coat, the pavement surface shall be thoroughly swept and cleaned of all excess material. The seal coat shall be bituminous material asphalt emulsion meeting the requirements of § 702-3101 or § 702-4101 applied at the rate of 0.3 to 0.5 gal/sy (Type 1 mix, Table 405-1) or 0.5 to 0.65 gal/sy (Type 2 mix, Table 405-1). This shall be immediately followed by an application of No. 1A cover aggregate at the rate of 15 to 20 lb/sy which shall then be rolled. In the case where multiple lifts of Cold Mix Bituminous Pavements are used, only the surface of the top course shall require a seal coat. In multiple lift construction, each lift requires an application of key stone to fill voids in the mat.

**405-4 METHOD OF MEASUREMENT.** The bituminous cold mix pavement shall be measured by the number of tons of compacted aggregate, including key and cover stone, placed in accordance with the specifications.

The liquid bituminous material shall be measured by the liter.

**405-5 BASIS OF PAYMENT.** The unit price bid per ton shall include the preparation of base, the cost of furnishing all the aggregate, the mixing, placing, compaction and all labor and equipment necessary to complete the work. The bituminous material will be paid for under its appropriate item.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
405.01	Cold Mix Bituminous Pavement (Open Graded)	Ton

## **SECTION 406 WARM MIX ASPHALT (WMA) WITH POLYMER FIBERS**

**406-1 DESCRIPTION.** The work shall include the production and placement of warm mix asphalt with polymer fibers.

**406-2 MATERIALS.** Material requirements shall be as specified in the special specifications.

**406-3 CONSTRUCTION DETAILS.** The construction requirements shall be as specified in the special specifications.

**406-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**406-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 407 - TACK COAT**

**407-1 DESCRIPTION.** This work shall consist of preparing and treating an existing Portland cement concrete surface or hot mix asphalt surface with tack coat in accordance with the Contract documents and as directed by the Engineer.

**407-2 MATERIALS.** The tack coat shall meet the applicable requirements of §702. Use of alternative tack coat material requires prior approval by the Director, Materials Bureau.

### **407-3 CONSTRUCTION DETAILS.**

**407-3.01 Equipment.** A distributor shall be used for applying tack coat. The distributor shall be capable of applying the tack coat uniformly on variable widths of surface up to 15 feet.

The distributor equipment shall include a quantity measuring system and a thermometer for measuring temperature of tank contents. Prior to being used on a project, this equipment shall be calibrated in accordance with ASTM D 2995 *Standard Practice for Estimating Application Rate of Bituminous Distributors* or an equivalent calibration procedure acceptable to the Engineer. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

Distributors shall be equipped with circulation spray bars which shall be adjustable both laterally and vertically. An attached bristle broom that drags on the pavement behind the spray bars may be attached to the distributor. If the broom is used, it shall be adjustable laterally and vertically so that the full width of the applied tack coat is bristled uniformly into the pavement surface.

A bituminous material sampling valve shall be attached to the distributor. The distributor tank shall be equipped with an agitator that is capable of ensuring the tack coat remains homogeneous.

Tack coat stored in the distributor tank shall be heated and maintained at a temperature between 85°F and 160°F.

Hand operated spray units will be permitted only in areas where the use of a distributor is impractical. The Engineer will determine the final acceptance of all equipment used for applying the tack coat.

**407-3.02 Application of Tack Coat.** The tack coat contained in the distributor tank shall be homogeneous.

The tack coat shall be applied to a prepared clean pavement. Material shall be applied uniformly across the width of the designated area.

The tack coat shall not be applied on a wet pavement surface or when the pavement surface temperature is below 40°F.

The application rate shall be as determined in Table 407-1 *Tack Coat Application Rates*. These are recommended application rates for tack coat on various surface types and may be modified by the Engineer.

<b>TABLE 407-1 – TACK COAT APPLICATION RATES</b>		
<b>Surface Type</b>	<b>Application Rate (gal/yd<sup>2</sup>)</b>	
	Diluted Tack Coat	Straight Tack Coat
New Hot Mix Asphalt	0.05 - 0.06	0.03 - 0.04
Milled Surfaces and Existing Hot Mix Asphalt	0.08 - 0.10	0.05 - 0.06
Portland Cement Concrete	0.08 - 0.10	0.05 - 0.06
Vertical Surfaces (curbs, drainage structures, and appurtenances)	0.09 - 0.11	0.06 - 0.07

**407-3.03 Sampling.** The Engineer will request samples from the Contractor at the frequency listed in Materials Method 702-2 *Asphalt Emulsion - Quality Assurance*. The Engineer will witness the Contractor sampling the material. The sample will represent all material from the same certified lot, placed that day.

**407-4 METHOD OF MEASUREMENT.** The quantity to be measured for payment will be in gallons of tack coat measured at 60°F to the nearest gallon. The following formula will be used to calculate material quantity at 60°F:

$$\text{Volume @ 60°F} = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]$$

$$\Delta T = \text{Delivered Temperature (°F)} - 60$$

$$\text{Volume}_D = \text{Quantity at Delivered Temperature (gallons)}$$

**407-5 BASIS OF PAYMENT.** The unit price bid per gallon for tack coat shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

The Regional Materials Engineer will evaluate material represented by failing samples. If the Engineer elects to leave the material in place, the Contractor shall receive a pay reduction of 75% of the tack bid price, for the pavement section represented by the failing sample.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
407.0102	Diluted Tack Coat	Gallon
407.0103	Straight Tack Coat	Gallon

## SECTIONS 408 AND 409 (VACANT)

### SECTION 410 – CHIP SEAL

(Last Revised September, 2016)

**410-1 DESCRIPTION.** This work shall consist of the construction of a single course chip seal for pavements and/or shoulders in accordance with the contract documents.

#### 410-2 MATERIALS

**410-2.01 Bituminous Materials.** The bituminous material shall meet the applicable requirements of Section 702.

**A. Bituminous Material – Pavement and Shoulders.** Ensure that the bituminous material is compatible with the selected aggregate; use item 702-3101P, 702-3102P or 702-4101P.

**B. Bituminous Material – Shoulders.** For shoulders only, the Contractor shall use item 702-3301P or 702-4201P.

**C. Fog Seal.** The Contractor shall provide material meeting the requirements of Section 702, Table 702-7, Diluted Tack Coat; or use an alternate material approved by the Director, Materials Bureau.

**410-2.02 Aggregates.** The aggregate shall conform to the requirements of §703-02, Coarse Aggregates, except as modified herein. The aggregate size shall be No. 1ST or No. 1A, as specified. The aggregate's flakiness index shall meet the requirements of Materials Method 410, *Chip Seal Mix Design*.

**A. Aggregate – Pavement.** The aggregate shall meet one of the following requirements:

1. Limestone or a blend of limestone and dolomite having an acid insoluble residue content not less than 20.0%
2. Dolomite.
3. Sandstone, granite, chert, trap rock, ore tailings, or other similar non-carbonate materials.
4. Use gravel or blend two or more of: gravel, limestone, dolomite, sandstone, granite, chert, trap rock, ore tailings, or other similar materials to meet the following requirements:
  - a. Size 1ST Aggregate. Produce a final blend having noncarbonate plus 1/4 inch particles comprising at least 20.0% of the total aggregate by weight with adjustments to equivalent volumes for materials of different specific gravities.
  - b. Size 1A Aggregate. Produce a final blend having noncarbonate plus 1/8 inch particles comprising at least 20.0% of the total aggregate by weight with adjustments to equivalent volumes for materials of different specific gravities.

**B. Aggregate - Shoulders.** The aggregate shall conform to the requirements of §703-02, Coarse Aggregates.

**C. Stockpile.** Build an aggregate stockpile at a location approved by the Engineer. When blending multiple aggregates, use automated proportioning and blending equipment to produce a uniformly graded stockpile.

**410-2.03 Cover Sand.** Use cover sand conforming to the requirements of §703-01, Fine Aggregate or §703-02, Coarse Aggregate except as modified in Table 410-1 Cover Sand.

Table 410-1 Cover Sand	
Screen Size	Percent Passing
1/8	90-100
No. 200	0-3

#### 410-2.04 Material Sampling and Testing

##### A. Aggregate Stockpile.

1. **Contractor Testing.** The Contractor shall perform the following tests and submit the results to the Regional Materials Engineer.
  - a. Obtain three samples, according to ASTM D75, *Standard Practice for Sampling Aggregates*. Each sample must contain material from each face of the stockpile.
  - b. Test samples in accordance with AASHTO T 11, *Materials Finer than #200 Sieve in Mineral Aggregates by Washing*, and AASHTO T 27, *Sieve Analysis of Fine and Coarse Aggregates*. Test results shall be based on the average of three tests.
  - c. When required, sample and test the aggregate in accordance with Materials Method 28, *Friction Aggregate Control and Test Procedures*.
  - d. Determine the aggregate's flakiness index as defined by Materials Method 410, *Chip Seal Mix Design*.

2. **Department Testing and Approval.** The Department may elect to sample the aggregate stockpile prior to allowing the Contractor to begin work.

Aggregate is subject to quality assurance (QA) testing by the Regional Materials Engineer. Each day of work, the Department will witness and take possession of an aggregate sample obtained by the Contractor. The sample will be taken from the portion of the stockpile to be used in that day's production, and represent the entire quantity of aggregate placed that day.

The Department will evaluate any material failing QA testing to determine if it will be left in place. Material represented by a sample failing QA testing that is left in place will be subject to pay reductions.

Samples shall meet appropriate friction values. All chip seal previously placed with material from a stockpile rejected for non-carbonate or acid insoluble residue content will be rejected.

**B. Cover Sand.** Sampling and gradation testing of cover sand shall be performed according to the requirements of 410-2.04 A.1. Copies of test results shall be furnished to the Department prior to applying the cover sand.

**C. Bituminous Material.** Bituminous material is subject to QA testing by the Materials Bureau. The Engineer will evaluate any material failing QA testing to determine if it will be left in place. Material represented by a sample failing QA testing that is left in place will be subject to pay reductions.

**410-2.05 Mix Design.** Complete a mix design for pavements and/or shoulders in accordance with Materials Method 410. A shoulder mix design is required when Contractor operations require the shoulder to be treated separately from the mainline. Mix designs shall be submitted to the Engineer a minimum of two weeks prior to the start of the work.

#### 410-3 CONSTRUCTION DETAILS

##### 410-3.01 General

**A. Weather and Seasonal Limitations.** Chip Seal shall be placed during the period from May 1<sup>st</sup> through September 7<sup>th</sup>. Material shall not be applied to a pavement surface when the:

1. Surface has standing water or is saturated.
2. Surface temperature is less than 60°F.
3. Ambient temperature is less than 50°F.
4. Weather conditions would prevent proper construction of the chip seal.

**B. Equipment.** All equipment shall be maintained in satisfactory working conditions at all times.

**1. Sweepers**

**a. Self-propelled Rotary Power Broom.** The self-propelled rotary power broom shall be designed, equipped, maintained and operated so the pavement surface can be swept clean.

**b. Self-propelled Pick Up Broom or Vacuum Sweeper.** The self-propelled equipment shall be designed, equipped, maintained and operated so that the pavement can be swept clean. Excess aggregate shall be contained in an onboard hopper and disposed of.

**2. Bituminous Material Distributor**

a. The distributor shall be equipped, maintained, and operated so that bituminous material can be applied uniformly on variable widths up to 15 feet; and at controlled temperature and rates from 0.05 to 0.55 gallons per square yard. Prior to starting work, the distributor shall be calibrated for transverse and longitudinal application rate by ASTM D 2995, *Standard Practice for Estimating Application Rate of Bituminous Distributors*, or an equivalent method approved by the Engineer. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

b. The distributor shall uniformly apply the bituminous material at the specified rate with a maximum allowable variation of 0.02 gallons per square yard.

c. Distributor equipment shall include accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with full circulation spray bars adjustable laterally and vertically. The distributor shall be equipped with a bituminous material sampling valve.

**3. Aggregate Spreader**

The aggregate spreader shall be a self-propelled unit capable of uniformly spreading the aggregate at the required rate on a minimum width of 6 inches wider than the width of the lane to be treated. Prior to starting work, the spreader shall be calibrated using ASTM D 5624, *Standard Test Method for Determining the Transverse-Aggregate Spread Rate for Surface Treatment Applications*. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

**4. Pneumatic Tire Roller**

Pneumatic tire rollers shall be self-propelled and have oscillating wheels with smooth tread tires and will have a minimum ground contact pressure of 80 psi. The tire pressure for all wheels shall be uniform within  $\pm 5$  psi. The rollers shall be operated at a maximum speed of 5 mph. Refer to Table 410-2 Number of Rollers for the minimum number of rollers required.

**C. Surface Preparation.** Perform all surface preparations prior to applying the chip seal.

1. Thoroughly clean the entire area to be overlaid of dirt, oil, and other foreign materials. Remove all debris and standing water.
2. Cover all manhole covers, water boxes, catch basins, and other such utility structures within the area being treated with plastic, building felt, or other material approved by the Engineer. Remove

the covers each day.

3. The Contractor shall remove pavement markings.

#### 410-3.02 Chip Seal

**A. Application of Bituminous Material.** Bituminous material shall be applied in a uniform, continuous spread over the section to be treated and within the temperature range recommended by the manufacturer. The Contractor shall document and report to the Engineer any field changes in application rates from the mix design submittal.

Where longitudinal joints are to occur, the application of bituminous material from the initial pass shall extend 6 inches beyond the area to be covered with aggregate. Subsequent passes of the bituminous spreader shall overlap the exposed bituminous material and the edge of the initial aggregate pass.

Uncovered bituminous material shall not be exposed to traffic. All bituminous material shall be covered with aggregate before opening to traffic.

The distributor shall be moving forward at proper application speed at the time the spray bar is opened. If any skipped areas or deficiencies occur, the operation shall be immediately stopped. The bituminous material shall not be applied more than 200 feet in advance of the self-propelled aggregate spreader. The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous material on the surface of the roadway.

**B. Application of Cover Aggregate.** Immediately following the application of the bituminous material, cover aggregate shall be spread at the rate established by the Contractor in the mix design. The Contractor shall document and report to the Engineer any field changes in application rates from the mix design submittal. Spreading shall be accomplished in such a manner that construction equipment or other vehicles shall not drive on the uncovered and newly applied bituminous material. Any free bituminous material on the surface caused by a deficient amount of cover aggregate shall be covered by broadcasting additional aggregate over the deficient area.

Longitudinal joints shall be parallel to the centerline. Ensure that longitudinal joints will correspond with the edges of the proposed traffic lane. Where any construction joint occurs, the edges shall be broomed back and blended so there are no gaps and the elevations are the same, and free from ridges and depressions.

Initial rolling of cover aggregate shall occur within 5 minutes after the application of bituminous material. Cover aggregate shall receive a minimum of three roller passes within 30 minutes of bituminous material application. Use Table 410-2 Number of Rollers to determine the minimum number of rollers required:

Overlay width (feet)	Number of Rollers (minimum)
$\leq 6$	1
$> 6 \leq 9$	2
$> 9 \leq 12$	3
$> 12$	4

**C. Sweeping.** Prior to opening the roadway to unguided traffic, sweep loose stone from the newly treated surface. Additional sweeping shall be performed as directed by the Engineer during a 5-day period following placement of the chip seal.

**D. Opening to Traffic.** After chip seal application, controlled traffic may be permitted at the

Contractor's option. Traffic shall be maintained at a speed not to exceed 15 mph for a period of 3 hours after placement of the chip seal by the use of pilot vehicles or an alternative method approved by the Engineer.

- Traffic Advisory Signs - immediately after completion of the chip seal, the section shall be signed with black on orange W8-7 *LOOSE STONE* signs and black on orange 30 MPH W13-1P advisory speed plaques for a period of seven days. The warning sign and the advisory speed plaque shall be installed on the same post as specified in the MUTCD. The signs shall be posted at ½ mile intervals. The first sign shall be posted in advance of the section in accordance with the MUTCD. The day and night visibility of the sign assemblies shall be enhanced by either 18 inch square orange flags for daytime visibility and low intensity Type A flashing warning lights for night visibility or high intensity Type B flashing warning lights for 24 hour visibility.

Use Table 410-3 Pilot Vehicles to determine the number of pilot vehicles required:

Table 410-3 Pilot Vehicles	
Lane Miles Surfaced In Previous Three Hours	Number of Pilot Vehicles
< 2	1
≥ 2	2

**E. Application of Fog Seal.** Prior to applying fog seal, the surface shall be swept. Follow the requirements of Application of Bituminous Material. The fog seal application rate is 0.05 to 0.15 gallons per square yard.

**F. Application of Cover Sand.** Within 5 minutes of applying the fog seal, spread the cover sand uniformly over the fog seal at an application rate of 2-5 pounds per square yard.

**G. Opening to Traffic After Fog Seal and Cover Sand.** The Contractor shall determine when traffic may be permitted on the treated chip seal. More time may be required for areas with limited exposure to sunlight.

**410-4 METHOD OF MEASUREMENT.** The quantity of chip seal to be measured for payment will be square yards of material in place, making no deductions for minor untreated areas such as catch basins and manholes.

The bituminous material for the chip seal will be measured by the number of 60°F gallons incorporated in the work.

The bituminous material for the fog seal will be measured by the number of 60°F gallons incorporated in the work.

The following formula will be used to calculate bituminous material quantity at 60°F:

$$\text{Volume @ 60°F} = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]$$

Where:

$$\Delta T = \text{Delivered Temperature (°F)} - 60$$

$$\text{Volume}_D = \text{Quantity Delivered (gallons)}$$

Cover Sand will be measured by the number of square yards of material in place, making no deductions



for minor untreated areas such as catch basins and manholes.

**410-5 BASIS OF PAYMENT.** The unit price bid per square yard for chip seal shall include the cost of all labor, materials and equipment necessary to perform the work. Pavement cleaning, pavement marking removal, work zone traffic control and pilot vehicles will be paid for separately.

If QA test results for aggregate exceed the rejection limit in Table 410-4, the Regional Materials Engineer will evaluate if the material can remain in place. If the material is left in place, the chip seal item will be subject to a reduction in payment according to Table 410-4:

TABLE 410-4 CHIP SEAL PAY TABLE		
1ST Aggregate		
	Pay Reduction	Rejection Limit % Passing
1/2 Sieve	$(100 - X) * 10$	< 97
1/4 Sieve	$(X - 15) * 5$	> 20
200 Sieve	$(X - 1.5) * 50$	> 2
Flakiness Index	$(X - 25) * 5$	> 30
1A Aggregate		
	Pay Reduction	Rejection Limit % Passing
1/2 Sieve	$(100 - X) * 10$	< 97
1/4 Sieve	$(90 - X) * 5$	< 85
1/8 Sieve	$(X - 15) * 5$	> 20
200 Sieve	$(X - 1.5) * 50$	> 2
Flakiness Index	$(X - 25) * 5$	> 30

X = QA % Passing test value. Negative values indicate full payment. The QA results for the 200 sieve and Flakiness Index will be calculated to the nearest tenth. All other QA values will be rounded to the nearest whole number.

Bituminous material used for chip seal will be paid for under a separate item as the number of 60°F gallons of material used.

Bituminous material for the fog seal will be paid for under a separate item as the number of 60°F gallons of material used.

The Engineer will evaluate any bituminous material failing QA testing to determine if it will be left in place. If the material is left in place, the bituminous material will be subject to a reduction in payment according to Table 410-5:

Table 410-5 Bituminous Material Pay Table	
Number of Failing QA Test Results	Pay Reduction of Bituminous Material Item
1	15%
2	25%

Cover sand will be paid for under a separate item.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
410.10	Chip Seal (1A)	Square Yard
410.20	Chip Seal (1ST)	Square Yard
410.30	Bituminous Material (Chip Seal)	Gallons
410.40	Bituminous Material (Fog Seal)	Gallons
410.50	Cover Sand	Square Yard
410.60	Pick Up Broom or Vacuum Sweeper	Each

**SECTION 411 - STABILIZED GRAVEL SURFACE COURSE**

(Last Revised January, 2020)

**411-1 DESCRIPTION.** The work shall consist of placing a stabilized gravel surface course with additive, if specified, on a prepared base in accordance with these specifications and in conformance with the lines and grades shown on the plans or as directed by the Engineer.

**411-2 MATERIALS**

**411-2.01 Gravel.** The gravel shall conform to the following gradation requirements:

<b>Sieve Size</b>	<b>Percent Passing by Weight</b>
2 in	100
1/4 in	30 - 65
No. 200	10 - 20

Particles passing the No. 40 sieve size shall have a maximum liquid limit of 30 and a plasticity index ranging from 3 to 8. The maximum loss in 4 cycles of the Magnesium Sulfate Soundness Test shall be 30. If the gravel as obtained from the bank is deficient in any of the requirements specified, such deficiency shall be corrected by screening, processing and/or blending with other acceptable materials before stockpiling. The requirements of §733-04 B, Stockpiling shall apply to all gravel furnished for this work.

**411-2.02 Chemical Additives.** Chemical additives, if required, shall meet the applicable requirements of the following subsections:

Calcium Chloride	712-02
Sodium Chloride	712-03

**411-3 CONSTRUCTION DETAILS**

**411-3.01 Placement.** After the base has been brought to grade and cross section, as shown on the plans, thoroughly compacted, and approved by the Engineer, the Contractor shall place the stabilized gravel surface course.

When calcium or sodium chloride additives are specified, they shall be added by an approved mechanical distributor after the gravel has been spread and prior to the addition of water. Calcium chloride shall be added in the amount of 1/2 pound per square yard per inch of compacted thickness of the course. Sodium chloride shall be added at a rate of 2 pounds per square yard per inch of compacted thickness of the course which is equivalent to approximately 2% of sodium chloride based on dry weight of aggregate. Water shall then be added to the material in amounts as directed by the Engineer.

If the Contractor so elects, only the calcium chloride may be added to the gravel material as a water solution. In such cases the Contractor shall submit to the Engineer a detailed description in writing of the

proposed procedure of operations. Construction shall not be started until the Engineer's approval is obtained in writing.

#### **411-3.02 Mixing**

**A. Gravel Without Additive.** Water shall be thoroughly dispersed by any appropriate methods which will insure a uniform consistency and moisture content within the limits for proper compaction.

**B. Gravel With Additive.** The water and the chemical additive shall be thoroughly and uniformly incorporated with the gravel for the full depth of the course, by mixing with an approved power-driven rotary type mixing machine. Mixing shall continue until the material is of uniform composition. The Contractor may elect to mix the materials in an approved plant of the pugmill type. Mixing by blading, shoveling and/or scooping will not be permitted.

**411-3.03 Compaction.** When the in-place material is of uniform consistency and has a moisture content within the limits for proper compaction, as determined by the Engineer, it shall be thoroughly compacted by the use of self-propelled pneumatic tired or vibratory compactor in accordance with the requirements of Section 203, *Compaction*. During the compaction operation, light grading shall be done as required to maintain the surface of the course true to grade and cross-section. In confined areas, inaccessible to rollers, mechanical rammers shall be used to obtain the compaction required in §203-3.03C. The finished surface of the stabilized gravel course shall be rolled in a float of free water with a smooth steel wheeled roller weighing not less than 10 tons. In all cases, the material must be so thoroughly compacted that it will not displace under the roller.

This course shall not be placed in excess of 500 linear feet without being shaped, compacted and finish rolled.

When posts for guide railing are to be installed adjacent to a stabilized gravel surface course, extreme care shall be taken during installation of the posts so that the stabilized gravel surface course is not disturbed.

#### **411-3.04 Surface Preparation for Treatment**

**A. Calcium Chloride Stabilized Gravel Surface Course.** After the calcium chloride stabilized gravel surface course has been completed, water shall be applied to the surface in amounts as directed by the Engineer. Immediately following the application of water, calcium chloride shall be applied on the surface with an approved mechanical spreader at the rate of 1/2 pound per square yard.

**B. Sodium Chloride Stabilized Gravel Surface Course.** After the sodium chloride stabilized gravel surface course has been brought to final grade and cross section and rolling has been completed, the course shall be permitted to cure for a minimum of 10 days at a minimum temperature of 60°F before any additional pavement courses are applied. The cured completed surface course shall be broomed to remove dust, before application of the overlying course.

**C. Gravel Without Additive.** No surface preparation required for treatment.

**411-4 METHOD OF MEASUREMENT.** The quantity for payment, in cubic yards of material, shall be computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and in accordance with the plans and specifications.

**411-5 BASIS OF PAYMENT.** The unit bid price per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that the water, the calcium chloride, and the sodium chloride shall be paid for under their appropriate items. No direct payment will

be made for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage, or any other causes; the cost of such losses shall be included in the price bid for this work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
411.01	Stabilized Gravel Surface Course	Cubic Yard
411.02	Calcium Chloride Stabilized Gravel Surface Course	Cubic Yard
411.03	Sodium Chloride Stabilized Gravel Surface Course	Cubic Yard

## **SECTION 412 - CRACK SEALING ASPHALT PAVEMENTS**

**412-1 DESCRIPTION.** The work in this section shall include work required for crack sealing asphalt pavements.

**412-2 MATERIALS.** Materials shall be as specified in the special specifications.

**412-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**412-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**412-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 413 - MICRO-SURFACING**

**413-1 DESCRIPTION.** The work in this section shall include work required for micro-surfacing.

**413-2 MATERIALS.** Materials shall be as specified in the special specifications.

**413-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**413-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**413-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 414 - QUICK-SET SLURRY**

**414-1 DESCRIPTION.** The work in this section shall include work required for quick-set slurry.

**414-2 MATERIALS.** Materials shall be as specified in the special specifications.

**414-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**414-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**414-5 BASIS OF PAYMENT.** As specified in the special specifications.”

## **SECTION 415 - PAVER PLACED SURFACE TREATMENT**

**415-1 DESCRIPTION.** The work in this section shall include work required for paver-placed surface treatment.

**415-2 MATERIALS.** Materials shall be as specified in the special specifications.

**415-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**415-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**413-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 416 - COLD RECYCLING**

**416-1 DESCRIPTION.** The work in this section shall include work required for cold recycling.

**416-2 MATERIALS.** Materials shall be as specified in the special specifications.

**416-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**416-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**416-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 417 – HOT MIX ASPHALT USING RECYCLING TREATMENTS**

(New Section January, 2017)

**417-1 DESCRIPTION.** This specification includes two processes for in-place recycling hot mix asphalt pavements: heater scarification (HS) and hot-in-place recycling (HIPR). The HMA pavement surface is heated using specialized equipment to soften the asphalt.

In the HS process, the softened HMA surface is scarified to a specified depth as detailed in the contract documents. The scarified asphalt pavement is then mixed with a recycling agent that rejuvenates the asphalt. This mix is then placed and compacted back onto the roadway. The scarified layer must be overlaid.

In the case of the HIPR, the multi-step recycling process of the existing pavement includes heating, milling, and adding a recycling agent to rejuvenate the asphalt; then mixing, placing, and compacting the mixture. The resulting recycled pavement does not require an overlay. If the contract documents require the addition of virgin HMA 19.0 mix during the HIPR process, then the resulting pavement will require an overlay.

**417-2 MATERIALS**

**417-2.01 Recycling Agent.** Use a recycling agent specifically designed as a rejuvenator meeting the requirements outlined in Section 702 – *Bituminous Materials*, 8. *Asphalt Recycling Agent*, Table 702-9 *Recycling Agent* or Table 702-10 *Emulsified Recycling Agent*. At the start of and during production, provide certified test results and documented quantities to the Engineer for each shipment of recycling agent. The use of any other grade of recycling agent or other product requires prior approval from the Director, Materials Bureau. A minimum 2-week notice is needed for this approval.

**417-2.02 Mixture Design.** Determine the application rate of the recycling agent for heater scarification and hot in-place recycling by taking and analyzing a minimum of three cores per lane mile or a maximum of 20 cores per project from the existing HMA pavement. Take these cores from locations that represent the entire project condition.

Make sure that the designed application rate of the recycling agent provides the average penetration value of the recovered asphalt binder from the loose mix samples, taken during both the HS and HIPR process, to have an increase of at least 30% or more than the average penetration value of the recovered asphalt binder from the existing pavement cores. Do not exceed the final penetration value of 90. Perform all the sample tests for the penetration values in accordance with AASHTO T 49, *Penetration of Bituminous Materials*.

**417-2.03 Virgin Hot Mix Asphalt.** When specified in the contract documents, add virgin 19.0 HMA binder mix to the Hot-In-Place Recycling mixture. Provide virgin HMA meeting the requirements outlined in Section 402 – *Hot Mix Asphalt (HMA) Pavements*. The contract proposal will include the performance-graded (PG) binder, mix type, mix design level, and rate of virgin HMA. Do not use RAP in the virgin HMA mix.

**417-3 CONSTRUCTION DETAILS.** §401-3 and §402-3, *Construction Details*, apply, except as modified below:

#### **417-3.01 General**

**A. Pavement Markings.** Remove all epoxy or thermoplastic pavement markings, and other markings when ordered by the Engineer.

**B. Cleaning.** Clean the existing pavement and shoulder to be heater scarified or hot in-place recycled by using mechanical sweepers, or other effective means until the surface is free of all debris material, which might interfere with the scarification or milling process.

**C. Calibration for Spray Unit and Recycling Injection System.** Calibrate the metering system in accordance with NYSDOT's Materials Procedure (MP) 417-01 - *Calibration of Metering System for Recycling Equipment*. Other calibration methods may be used with the approval of the Engineer. A minimum 2-week notice is required when scheduling this calibration. Perform the calibration of the metering system in the presence of the Regional Materials Engineer or designee. Work shall not progress until the calibration has been completed and verified. Each project requires an approved calibration. Approved calibrations are valid for 90 days and may be used for more than one project. If the calibration date exceeds 90 days, then recalibrate the metering system.

#### **417-3.02 Heater Scarification (HS).**

**A. Heater Scarification Train.** The heater scarification train consists of at least two heating units and a heater scarification unit consisting of a scarifier, a sprayer, a milling/remixer drum, and a screed.

**1. Preheating or Heating Unit.** This unit must generate sufficient radiant heat with no open flame to soften the asphalt pavement to the depth required. The burner assembly must be adjustable to heat between 8 and 14 feet in width. The entire heating unit must be enclosed and vented to contain the heat and prevent damage to adjacent properties and landscape. Additional heating units may be required if the temperature behind the screed does not meet specification requirements.

**2. Heater Scarification Unit.** This equipment must be a self-contained machine designed to reprocess only the upper layers of the existing HMA pavement. The heater scarification unit must be self-propelled and capable of operating at speeds of 8 to 26 feet per minute while uniformly heating and scarifying the existing HMA pavement to the minimum loose mix depth specified in the contract documents. Listed below are the various units that are part of the heater scarification train.

**a. Scarifier.** The scarifying unit must contain at least 2 rows of spring-loaded tines that are adjustable to scarify 8 to 14 feet wide. The tines in a row must be no more than 1.0 inch apart. This unit must also be able to conform to the pavement contours to ensure a uniform penetration from the tines and prevent damage to utility structures.

**b. Sprayer.** This unit must be immediately behind the scarifying unit and capable of uniformly applying the recycling agent to the reclaimed asphalt pavement at the approved rate. Select the size of the nozzles located on the spray bar and pump based upon the rate of application and the forward speed of the heater scarification unit. This unit must be equipped with a measuring system which is capable of maintaining the required application rate of the recycling agent within a tolerance of  $\pm 5\%$  for the mix design. The measuring system must continuously verify and display the application rate of recycling agent and cumulative total with respect to the volume of scarified material for the road surface.

**c. Mill/Remixer.** Immediately following the application of the recycling agent, an enclosed milling unit is required to mill the asphalt pavement to the loose mix depth specified in the contract documents, thoroughly mixing the recycling agent with the scarified and milled pavement. The mill/remixer unit is an integral part of the scarifying machine and must be located between the spray unit, which applies the recycling agent, and the screed. This unit must be operated hydraulically and able to work at variable speeds up to 120 rpm.

**d. Screed.** The attached heated, augured vibratory screed must be able to uniformly distribute the hot scarified material to the desired longitudinal and transverse section. The screed must be adjustable from 8 to 14 feet wide, equipped with an adjustable crown control and each end of the screed must have hand wheel adjusting screws for providing the desired longitudinal grade and transverse slope.

## **B. Mixture Verification and QC Testing.**

**1. First day:** Prior to the scarification process, the Engineer will select two core locations on the existing pavement. These locations will be within a lane mile or fraction thereof if production is less than one mile. Extract two cores at each location and test one core from each location for penetration of the extracted asphalt binder from the surface layer only. Provide the companion core from each location to the Engineer for testing by the Department for verification purposes.

During the scarification process, take four loose mix samples prior to compaction at each location where cores were taken. These samples will be representative of the day's production. Take samples either behind the screed or any place after the spraying and mixing units. Identify all samples by their locations at the project site. Test two of the loose mix samples from each core location for penetration and provide the other two loose mix samples to the Engineer, which may be evaluated by the Department's Lab to verify test results. Take all the required core and loose mix samples after the first 500 feet of the day's production.

Submit penetration test results to the Engineer by the end of the next day's production. If test results are not provided, the Engineer may shut down the scarification process until the results are submitted. Determine the penetration of the PG binder recovered from the recycled mixture in accordance with AASHTO T 49. The average penetration value of the loose mix samples must be at least 30% or more than the penetration of the core samples taken from the existing pavement.

If the average penetration values of the loose mix samples fail to meet this requirement, adjust the application rate and submit the new adjusted application rate to the Engineer. Repeat the procedure described above for taking and testing samples. Submit the penetration test results to the Engineer by end of the next day's production. Continue adjusting the application rate and taking samples until average penetration values of the loose mix samples meet the specification requirement of at least 30% or more than the penetration values of the core samples.

**2. Routine Day:** If the specification requirements are met after the first day's production, take samples as described above every three days of production for quality control and quality assurance purposes. Samples of the scarified pavement prior to rejuvenation can be taken as an option instead of the core samples. When sample results do not meet the specification requirements, make adjustment to the application rate and take samples as described above.

If, at anytime, the average penetration value of the loose mix samples is greater than 90, the Engineer may evaluate the pavement section and request the scarified pavement be removed and replaced at no additional cost to the State. The evaluation may include, but not limited to, testing penetration of the core sample, location of the section, etc. If core samples are required for this evaluation, take them at no additional cost to the State and submit them to the Department for testing. Also, if the recycled pavement is not satisfactory to the Engineer, additional tests may be required at no cost to the State.

**C. Placement.** Radiantly heat the existing HMA pavement surface with no open flame using specialized equipment to soften the HMA surface and scarify to a specified depth as detailed in the contract documents. Take care not to overheat the existing pavement thereby softening the underlying asphalt pavement not to be milled or scarified and that burning of the existing asphalt cement does not occur. Operate the heating unit(s) in a manner to prevent damage to adjacent property and vegetation. Repair all heat-damaged areas immediately, at no additional cost to the State.

Control the heater scarification equipment to ensure the temperature of the scarified mixture is maintained between 275°F and 325°F. Verify this temperature within 5 feet behind the screed unit.

Control the speed of the equipment to ensure that the recycled pavement is properly milled, mixed, and uniformly distributed to the proper thickness, slope, and crown shown on the contract plans. Take extra care in controlling heater scarification equipment to prevent segregation of the recycled mix at the start and end of paving production as well as any points where the heater scarification train needs to stop and restart. Control the width of each pass to provide proper placement of longitudinal joints, including a 3-inch overlap onto adjacent lane passes.

Add recycling agent uniformly to the scarified HMA pavement at the predetermined application rate to produce a homogenous HMA recycled mix.

Ensure that the final recycled pavement conforms to the requirements of §402-3.10, *Surface Tolerance* and §402-3.11, *Thickness Tolerance*. Measure the depth of the loose scarified mix behind the screed unit prior to the rolling operation. Adjust the paving equipment if the loose mix depth does not provide the compacted depth specified in the contract documents.

In areas not accessible to scarifying equipment, such as around catch basins or manholes, the Engineer will determine if they require repair. Pavement surfaces that are in good condition do not require repair. Repair all areas with cracks or spalls, as approved by the Engineer, at no additional cost to the State.



**D. Compaction.** Compact the recycled mixture in accordance with §402-3.07, D., *80 Series Compaction Method*.

**E. Overlay.** Once work is completed, overlay the recycled HMA pavement to the satisfaction of the Engineer. Place the overlay prior to the end of the paving season. This work must be done under a separate pay item in the contract documents.

#### **417-3.03 Hot In-Place Recycling (HIPR).**

**A. Hot-In-Place Recycling Train.** The HIPR train consists of a preheating unit, main recycling unit consisting of a heating system, a hot milling unit, a recycling injection system, a blending unit/mixing chamber, and a conventional paver. The equipment must be capable of processing the existing pavement to a minimum depth of 2 inches. HIPR equipment approved for use will appear on the Department's Approved List. Detailed requirements and procedures for approval of the HIPR equipment are available from the Materials Bureau. A minimum of 30 days is required for approval consideration.

**1. Preheating or Heating Unit.** This unit must generate sufficient radiant heat with no open flame to soften the asphalt pavement to the depth required. The burner assembly must be adjustable to heat between 8 and 14 feet in width. The entire heating unit must be enclosed and vented to contain the heat and prevent damage to adjacent properties and landscape. Additional heating units may be required if the temperature behind the screed does not meet specification requirements.

**2. Main Recycling Unit.** This equipment must be a self-contained machine designed to reprocess only the upper layers of the existing HMA pavement. The HIPR train must be self-propelled and capable of operating at speeds of 8 to 26 feet per minute while uniformly heating and recycling the existing HMA pavement to the minimum loose mix depth specified in the contract documents. Listed below are the various units that are part of the HIPR train.

**a. Heating System.** This part of the main recycling unit must meet the same requirements for the preheater.

**b. Hot Milling Unit.** This unit must be capable of uniformly loosening the preheated asphalt pavement to the depth specified in the contract documents. The milling unit must be equipped with separate automatic grade controls operated from skis. The milling head must be extendable between 8 and 14 feet to accommodate various road widths and utility structures.

**c. Recycling Injection System.** The recycling equipment must have a recycling agent injection system with electronic controls so that the required application rate for the recycling agent is maintained at a tolerance of  $\pm 5\%$  from the mix design target. The recycling injection system must continuously verify and display the application rate of recycling agent and cumulative total with respect to the volume of milled material from the road surface.

**d. Blending Unit / Mixing Chamber.** The recycling equipment must have a chamber capable of blending the recycled pavement, virgin HMA, if any, and recycling agent into a homogenous, uniformly blended mixture. This equipment must be capable of placing the recycled mixture in a windrow to be conveyed into the HMA placement equipment. The Engineer may approve other methods.

#### **3. Asphalt Placement Equipment.**

**a. Pickup Conveyor.** This equipment must have the capability to pick up the windrowed HMA recycled mixture on the roadway and convey it into the paving hopper where a surge of

HMA material is kept to ensure that a constant supply of asphalt material is available for the paver.

## **B. Mixture Verification and QC Testing.**

**1. Daily Quality Control (QC) Testing:** Ensure all tests are performed by a certified Quality Control Technician in accordance with §401-3.01, *Quality Control* and §401-3.02, *Production Facility Laboratory*, for the virgin hot mix asphalt.

**2. First day:** Prior to the recycling process, the Engineer will select two core locations on the existing pavement. These locations will be within a lane mile or fraction thereof if production is less than one mile. Extract two cores at each location and test one core from each location for penetration of the extracted asphalt binder from the surface layer only. Provide the companion core from each location to the Engineer for testing by the Department for verification purposes.

During the recycling process, take four loose mix samples prior to compaction at each location where cores were taken. These samples will be representative of the day's production. Identify all samples by their locations at the project site. Test two loose mix samples from each core location for penetration and provide the other two loose mix samples to the Engineer, which may be evaluated by the Department's Lab to verify test results. Take all the required core and loose mix samples after the first 500 feet of the day's production.

Submit penetration test results to the Engineer by the end of the next day's production. If test results are not provided, the Engineer may shut down the paving operations until the results are submitted. Determine the penetration of the PG binder recovered from the recycled mixture in accordance with AASHTO T 49. The average penetration value of the loose mix samples must be at least 30% or more than the penetration of the core samples taken from the existing pavement.

If the average penetration values of the loose mix samples fail to meet this requirement, adjust the application rate and submit the new adjusted application rate to the Engineer. Repeat the procedure described above for taking and testing samples. Submit the penetration test results to the Engineer by end of the next day's production. Continue adjusting the application rate and taking samples until average penetration values of the loose mix samples meet the specification requirement of at least 30% or more than the penetration values of the core samples.

**3. Routine Day:** If the specification requirements are met after the first day's production, take samples as described above every three days of production for quality control and quality assurance purposes. Samples of the recycled pavement prior to rejuvenation can be taken as an option instead of the core samples. When sample results do not meet the specification requirements, make adjustment to the application rate and take samples as described above.

If, at anytime, the average penetration value of the loose mix samples is greater than 90, the Engineer may evaluate the pavement section and request the recycled pavement be removed and replaced at no additional cost to the State. The evaluation may include, but not limited to, testing penetration of the core sample, location of the section, etc. If core samples are required for this evaluation, take them at no additional cost to the State and submit them to the Department for testing. Also, if the recycled pavement is not satisfactory to the Engineer, additional tests may be required at no cost to the State.

**C. Placement.** Radiantly heat the existing HMA pavement surface with no open flame using specialized equipment to soften the HMA surface and recycle to a specified depth as detailed in the contract documents. Take care not to overheat the existing pavement thereby softening the underlying asphalt pavement which is not to be milled and that burning of the existing asphalt cement does not

occur. Operate the heating unit(s) in a manner to prevent damage to adjacent property and vegetation. Repair all heat-damaged areas immediately, at no additional cost to the State.

Control the speed of the HIPR train to ensure that the recycled pavement is properly milled, mixed, and uniformly distributed to the proper thickness, slope, and crown as shown on the contract plans. Control the width of each pass to provide proper placement of longitudinal joints, including a 3-inch overlap onto adjacent lane passes.

Blend the milled asphalt pavement, recycling agent, and virgin HMA if specified, to produce a homogenous HMA recycled mix. Use the application rates of the recycling agent and virgin HMA as determined by the mix design. If virgin HMA is required, the addition into the recycling process must be within  $\pm 2.2$  lbs/yd<sup>2</sup> of the mix design target. The temperature of the recycled mixture must be between 250°F and 325°F prior to initial compaction.

Ensure that the final recycled pavement conforms to the requirements of §402-3.10, *Surface Tolerance* and §402-3.11, *Thickness Tolerance*. Measure the depth of the loose recycled mix behind the screed unit prior to the rolling operation. Adjust the paving equipment if the loose mix depth does not provide the compacted depth specified in the contract documents.

In areas not accessible to recycling equipment, such as around catch basins or manholes, the Engineer will determine if they require repair. Pavement surfaces that are in good condition do not require repair. Repair all areas with cracks or spalls, as approved by the Engineer, at no additional cost to the State.

**D. Compaction.** Compact the recycled mixture in accordance with §402-3.07, C., *70 Series Compaction Method*.

#### 417-4 METHOD OF MEASUREMENT

##### 417-4.01 General (Vacant)

**417-4.02 Heater Scarification (HS).** This work will be measured as the number of square yards of pavement surface recycled as detailed in this specification.

**417-4.03 Hot in-Place Recycling (HIPR).** This work will be measured as the number of square yards of pavement surface recycled as detailed in this specification.

Virgin HMA will be measured as the number of tons of hot mix asphalt furnished and incorporated in the work. A QAF of 1.00 will be assigned to virgin material meeting the specification requirements as tested by the QCT. A QAF of 0.85 will be assigned to virgin material that fails to meet the specification. Quality Units will be determined when there is a disincentive and will be calculated as per §402-4, *Method of Measurement*.

**417-4.04 Recycling Agent.** The quantity of recycling agent to be measured for payment will be the number of gallons incorporated in the work, measured at a temperature of 60°F. The following formula will be used to calculate material quantity at 60°F:

$$\text{Volume@ } 60^{\circ}\text{F} = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]$$

Where,

$\Delta T$  = Delivered Temperature (°F) – 60

Volume<sub>D</sub> = Quantity at Delivered Temperature (gallons)

**417-5 BASIS OF PAYMENT.** Removal of pavement markings and cleaning of the existing pavement will be paid under separate pay items in the contract documents.

**417-5.01 General (Vacant)**

**417-5.02 Heater Scarification (HS).** The unit price bid per square yard for this item shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including heating, scarifying, mixing, paving, compacting, coring, and testing of the recycled materials. No deduction will be made in areas such as catch basins or manholes where the scarifying equipment cannot be used.

**417-5.03 Hot in-Place Recycling (HIPR).** The unit price bid per square yard for this item shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including heating, milling, mixing, paving, compacting, coring, and testing of the recycled materials. No deduction will be made in areas such as catch basins or manholes where the recycling equipment cannot be used.

The provisions of §402-5, *Basis of Payment* shall apply for virgin HMA. When there is a disincentive, the payment adjustment will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is NOT to be altered in any manner by the bidder. Should the bidder alter the price shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the contract.

**417-5.04 Recycling Agent.** The unit price bid per gallon of recycling agent shall include the cost of all labor, material, and equipment necessary to complete the work satisfactorily. The Regional Materials Engineer will evaluate the material represented by any failing sample of recycling agent. If the Engineer elects to leave the material in place, the Contractor shall receive a pay reduction of 75% of the bid price of the recycling agent for the pavement section represented by the failing sample.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
417.01	Heater Scarification	Square Yard
417.02	Hot In-Place Recycling	Square Yard
417.0101	Recycling Agent	Gallon

**SECTION 418 – ASPHALT PAVEMENT JOINT ADHESIVE**

(New Section September, 2016)

**418-1 DESCRIPTION**

This work shall consist of furnishing and installing joint adhesive in accordance with the contract documents and as directed by the Engineer.

**418-2 MATERIALS**

Use a product which appears on the NYSDOT Approved List under ASPHALT PAVEMENT JOINT ADHESIVE (705-19) meeting the requirements of §705-19.

**418-3 CONSTRUCTION DETAILS**

**General.** Furnish all equipment that is necessary to clean the construction joint and to apply the joint adhesive. Use equipment meeting the description and/or performance requirements described herein and approved by the Engineer. Apply the joint adhesive to the construction joints.

**Joint Preparation.** Prepare longitudinal and transverse construction joints as discussed below and place adjacent asphalt pavement on the same day that the joint adhesive is applied.

Use a high pressure air lance to thoroughly clean the joint surface of dust, dirt, foreign material, sand and any other extraneous materials immediately prior to applying the joint adhesive. Install suitable traps or devices on the compressed air equipment to prevent moisture and oil from contaminating the joint surfaces. Maintain these devices and see that they are functioning properly. Protect the public from potentially objectionable and/or hazardous airborne debris.

**Joint Adhesive.** Heat and melt the joint adhesive in a melter constructed either as a double boiler filled with a heat-transfer medium between the inner and outer shells, or with internal tubes or coils carrying joint adhesive through a heated oil bath and into a heated double wall hopper. The melter will be equipped with separate thermometers to indicate the temperature of the heat transfer medium and the joint adhesive material, positive temperature controls, and with a mechanical agitator or a recirculation pump to assure a homogeneous blend of the joint adhesive.

Check the discharge temperature of the joint adhesive with a non-contact infrared thermometer or other suitable thermometer. Discharge the joint adhesive at the manufacturer's recommended application temperature and maintain the joint adhesive at  $\pm 10^{\circ}\text{F}$  of the application temperature indicated on the material packaging.

Applying joint adhesive is not permitted if the melter and discharge temperatures do not meet the requirements described above.

Equip the discharge hose with a thermostatically controlled heating apparatus or insulate it to maintain the proper joint adhesive application temperature. Holster the discharge hose to the melter if it is not thermostatically heat controlled. Circulate the joint adhesive from the discharge hose and the melter to maintain the proper joint adhesive application temperature.

Do not use joint adhesive material that has been heated beyond the safe heating temperature. If the manufacturer's recommendations allow the joint adhesive to be reheated or heated in excess of six hours, recharge the melter with fresh material amounting to at least 20 percent of the volume of the material remaining in the melter.

**Application.** Apply the joint adhesive when surface temperature is  $40^{\circ}\text{F}$  and rising. Use an applicator wand fitted with a sealing shoe to strike-off the adhesive. Strike-off the joint adhesive to provide a 1/4 inch to 3/8 inch thick band. The finished bands are to be approved by the Engineer.

**Wedge Joints.** Apply the joint adhesive to the entire vertical face and the upper 2 inches of the wedge joint.

**Butt Joints.** Apply the joint adhesive to the entire vertical face of the butt joint.

The joint adhesive will be considered cured when construction and/or vehicular traffic does not track or pick up the material. Reapply joint adhesive to any areas damaged by construction and/or vehicular traffic prior to placing the adjacent asphalt pavement.

#### **418-4 METHOD OF MEASUREMENT**

This work will be measured as the number of linear feet of joint adhesive satisfactorily furnished and installed.

#### **418-5 BASIS OF PAYMENT**

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
418.7603	Asphalt Pavement Joint Adhesive	Linear Foot

#### **SECTION 419 - FOG SEAL**

**419-1 DESCRIPTION.** The work in this section shall include work required for fog seal (stand alone for shoulder and median).

**419-2 MATERIALS.** Materials shall be as specified in the special specifications.

**419-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**419-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**419-5 BASIS OF PAYMENT.** As specified in the special specifications.

#### **SECTION 420 - POROUS ASPHALT PAVEMENT**

**420-1 DESCRIPTION.** The work in this section shall include work required for porous asphalt pavement.

**420-2 MATERIALS.** Materials shall be as specified in the special specifications.

**420-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**420-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**420-5 BASIS OF PAYMENT.** As specified in the special specifications.

#### **SECTIONS 421 THRU 489 - (VACANT)**

#### **SECTION 490 - COLD MILLING**

**490-1 DESCRIPTION.** This work shall consist of the milling, shaping and removal of portions of existing surfaces by a cold milling process, and subsequent cleaning, utilizing equipment and procedures meeting the requirements in this specification.

The work shall consist of Miscellaneous Cold Milling or Production Cold Milling of bituminous or portland cement concrete as indicated in the contract documents and as shown on the plans.

## **490-2 MATERIALS**

**490-2.01 Equipment.** Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. The machines shall have sufficient power, traction and stability to accurately maintain depth of cut and slope. They shall be capable of producing a finished profile and cross slope to within 1/4 inch of that required and shall produce a uniform surface texture free from gouges and ridges greater than 3/8 inch in depth.

The machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.

The machines shall have an integral loading system or sufficient equipment shall be provided to accomplish complete removal of milled material at a rate equivalent to the milling rate.

Vacuum trucks, street sweepers or power brooms shall be used to clean the milled surfaces. The Engineer may disallow the use of power brooms in urban, residential or other sensitive areas if the dust raised by the broom is deemed by the Engineer to be objectionable.

**490-2.02 Disposal of Material.** Material removed during the milling process, including foreign debris within or on the pavement, shall become the property of the Contractor and shall be disposed of at a site obtained by the Contractor.

## **490-3 CONSTRUCTION DETAILS**

**490-3.01 General.** Milling shall be performed at the locations and in accordance with the details indicated on the plans.

When indicated on the plans, profile and cross slope shall be controlled by a taut reference string line. The reference elevation and string line shall be established by the Contractor and subject to the approval of the Engineer.

Areas not accessible to the milling machine, such as around and/or adjacent to inlets, manholes, curbs and transverse joints on structures, may be removed by a small milling machine, handwork or other methods approved by the Engineer.

All milled material, including that removed by other means, shall be immediately removed from the milled surfaces and adjacent surfaces. Surfaces shall be cleaned of all fines and dust prior to opening to traffic. The Contractor shall conduct operations in such a manner that dust is controlled and is not objectionable. Milled and adjacent surfaces shall be cleaned again, as directed by the Engineer, prior to the placement of tack coats, or pavement courses if traffic has been allowed on the milled surface and/or if more than 48 hours have elapsed since the initial cleaning.

The Contractor shall maintain drainage at catch basins, according to the details shown on the plans, or in a manner approved by the Engineer.

When working adjacent to traffic, the Contractor shall immediately remove material that is spilled on the traveled way.

Milled surfaces to be overlaid with asphalt concrete shall be covered with at least a single course of asphalt concrete before the end of the paving season. Portland cement concrete overlays shall be completed over milled surfaces before the end of the paving season. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, fuel spillage or any contaminants which would inhibit bond, shall be repaired or remilled by the Contractor in a manner approved by the Engineer.

**490-3.02 Production Cold Milling.** Production cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

**490-3.03 Miscellaneous Cold Milling.** Miscellaneous cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

**490-3.04 Production Cold-Mill Surface Planing.** Production cold-mill surface planing of bituminous concrete surfaces shall be performed in accordance with the details and at the locations indicated on the plans. When specified, the milling machine shall control the profile and cross slope with a moving reference at least 30 feet in length. The moving reference may be a floating beam, ski, or other suitable type such that the resulting milled surface is sufficiently even.

In areas accessible to the milling machine, construct a milled surface to a maximum 1/2 inch tolerance. If the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, the Engineer may test the surface with a 15 foot straight edge or string line placed parallel to the centerline of the pavement and with a 10 foot straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 1/2 inch will be satisfactorily corrected at no additional cost to the State.

**490-4 METHOD OF MEASUREMENT.** The quantity shall be measured as the number of square yards of pavement surface milled in accordance with the plans and this specification.

In no case will a deduction in area be made for minor unmilled areas due to catch basins, manholes, transverse joints, or minor low areas in pavements from the measured surface area that has been milled. Minor unmilled or low areas are those areas of 10 square yards or less.

**490-5 BASIS OF PAYMENT.** The unit price bid per square yard shall include the cost of furnishing all labor and equipment necessary to complete the milling, including the removal of pavement by other means, the removal and disposal of milled material, the removal and hauling of milled material to a designated storage area when indicated in the contract documents and cleaning the resultant surface after milling. No payment will be made for additional cleaning that may be necessary just prior to placement of any overlaying pavement courses or tack coats. The cost of maintaining drainage shall be included in the price bid for work zone traffic control. The cost of providing tack coats, overlay courses, and temporary pavement wedges around drainage structures, manholes, valve boxes, bridge abutments and beginning and ends of milled pavement shall be paid for separately.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
490.10	Production Cold Milling of Bituminous Concrete	Square Yard
490.15	Production Cold-Mill Surface Planing of Bituminous Concrete	Square Yard
490.20	Production Cold Milling of Portland Cement Concrete	Square Yard
490.30	Miscellaneous Cold Milling of Bituminous Concrete	Square Yard
490.40	Miscellaneous Cold Milling of Portland Cement Concrete	Square Yard

**SECTIONS 491 THRU 499 (VACANT)**

# **Section 500**

## **PORTLAND CEMENT CONCRETE**

**SECTION 501 - PORTLAND CEMENT CONCRETE - GENERAL**

**501-1 DESCRIPTION.** These general requirements apply to concrete furnished for pavement, structures and incidental construction. Additional requirements may be specified in the contract item. All testing will be done in accordance with Department procedures.



## 501-2 MATERIALS

**501-2.01 Composition of Mixtures.** The Contractor shall inform the Regional Director, in writing, of the materials sources prior to mixing concrete. Proportion a homogenous Portland cement concrete mixture using the pre-approved materials listed under 501-2.02, Material Requirements.

Produce the class of concrete indicated in the contract documents. However, substitutions may be made according to Table 501-1, Concrete Class Options.

TABLE 501-1 CONCRETE CLASS OPTIONS	
Concrete Class	Allowable Class Options
A	C, E, F <sup>1</sup> , H or HP
C	HES <sup>2</sup>
D	DP
DP	None
E	H or HP
H	HP
F, G, GG, or HP	None
I	J
J	None

**Notes:**

1. Regional Director approval required for pavement applications, including approach slabs. D.C.E.S. approval required for structural or deck applications. May not be used in mass placements, or as a substitute for class A in Sign Structure, Signal Pole, and Luminary Foundations.
2. The requirements of §502-2.01 and §502-2.02 apply.

### 501-2.02 Material Requirements

Portland Cement	701-01	Admixtures	711-08
Blended Portland Cement	701-03	Fly Ash	711-10
Concrete Sand	703-07	Microsilica	711-11
Coarse Aggregate	703-02	GGBFS *	711-12
CNBCI **	711-13	HRP ***	711-14
Water	712-01	* Ground Granulated Blast Furnace Slag	
		** Calcium Nitrite Based Corrosion Inhibitors	
		*** High Reactivity Pozzolan	

**A. Cementitious Materials.** Use only cementitious materials meeting §701-01 whose brand name and type appears on the Department's Approved List. Cementitious materials stored over the winter at concrete producing facilities will be retested for specification compliance. All contaminated, or hardened cementitious material will be rejected and not used in Department work.

The Department will consider requests to evaluate alternate cements, pozzolan or microsilica. The use of alternatives is subject to approval by the Director, Materials Bureau.

**1. Portland Cement.** Use Type I, Type II or Type I/II cement, except as indicated below or in the contract documents.

Type I cement is restricted to fresh water and low sulfate soil areas. Use Type II or Type I/II cement in high sulfate, and salt water areas. Salt water areas are defined as; The Hudson River south of the Newburg-Beacon Bridge, and all other tidal / sea water spray areas of New York State. Type I/II cement is defined as a cement that meets the requirements of both Type I and Type II cements. High alkali cement is defined as any portland cement having an alkali content in excess of 0.70% as denoted on the Approved List. High alkali cement use is restricted, unless otherwise approved by the Regional Director, to mixtures that do not contain reactive aggregates ( as denoted in the Department's List of Approved Sources of Aggregates).

**2. Blended Portland Cement.** Blended cements meeting the requirements of 701-03, may be used as follows:

*a. Type IP or SM.* Blended Portland Cement (Type IP or Type SM), may be used in all classes of concrete listed in Table 501-03, Concrete Mixtures, except Class F. Type IP or SM blended cement replaces the portland cement/pozzolan portion of the designed mix in Class DP, G, GG, or HP concrete. When using Type IP or SM blended cement in Class DP and HP concrete, an addition of Microsilica §711-11 is required.

*b. Type SF.* Blended Portland Cement (Type SF), may be used in Class DP or HP concrete. Type SF blended cement replaces the portland cement/microsilica portion of the designed mix in Class DP or HP concrete. When using Type SF blended cement in Class DP or HP concrete, an addition of Fly Ash, §711-10, or Ground Granulated Blast Furnace Slag (GGBFS), §711-12, is required.

*c. Ternary Blend.* Blended Portland Cement (Ternary Blend), may be used in Class DP or HP concrete. Ternary blend cement in Class DP or HP concrete replaces the entire portland cement/pozzolan/microsilica portion of the designed mix. No subsequent addition of cementitious material is required or allowed.

**3. Pozzolan.** Pozzolan is defined as Fly Ash, §711-10, or Ground Granulated Blast-Furnace Slag (GGBFS), §711-12. All classes of concrete, except Class F, allow or require a pozzolan as a partial replacement for portland cement. Classes DP, G, GG, and HP concrete require the use of a pozzolan.

**4. Microsilica.** Class DP and HP concrete require Microsilica, §711-11, as a partial replacement for portland cement. Microsilica, a pozzolanic material, is not included in the definition of a pozzolan in these specifications.

**5. High Reactivity Pozzolan.** High Reactivity Pozzolans which meet the requirements of §711-14 may be considered as supplementary cementitious materials in concrete mixtures where enhanced physical properties are desired. With prior approval from the Regional Materials Engineer, these materials may be allowed in lieu of microsilica in specialized and high performance concrete mixtures.

**B. Aggregates.** Use aggregate from a source on the Approved List of Sources of Fine and Coarse Aggregates that also meets the following requirements for gradation and friction.

**1. Gradation.** Samples will be taken from stockpiles, barges, conveyor belts, or bins and tested for gradation at the plant site in accordance with NYSDOT Materials Method 9.1. Rejected aggregates may be reprocessed or reworked to meet the gradation requirements.

a. *Concrete Sand.* Use only sand meeting the requirements of §703-07, Concrete Sand.

b. *Coarse Aggregate.* Use only crushed stone, crushed gravel, or crushed slag meeting the requirements of §703-02, Coarse Aggregates in either one or a combination of size designations specified in Table 703-4, Sizes of Stone, Gravel, and Slag and graded according to Table 501-2, Coarse Aggregate Gradations.

Aggregates that are uniform in size, but do not meet the requirements in Table 703-4, may be approved by the Regional Director. When these sizes are combined to meet the mixture gradation requirements of Table 501-2, the gradation requirements of §703-02 shall not apply. Blending of aggregates during the batching process may be approved by the Regional Director. When blending aggregates prior to batching, the blending method requires approval by the Regional Director.

TABLE 501-2 COARSE AGGREGATE GRADATIONS		
Sieve Sizes	Type CA 1 General Limits % Passing	Type CA 2 General Limits % Passing
1 1/2 inches	-	100
1 inch	100	93-100
1/2 inch	90-100	27-58
1/4 inch	0-15	0-8

**NOTES:**

ASTM C33 Size Number 7 is an acceptable equivalent to the Type CA 1 gradation.

ASTM C33 Size Number 57 is an acceptable equivalent to the Type CA 2 gradation.

Material passing the No. 200 sieve (wet) is limited to a maximum 1.0 % by weight for ASTM sizes 7 and 57.

**2. Friction.** Sample and test aggregate for friction characteristics according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures.” The Engineer will identify pavement areas, if any, represented by failing samples according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures.”

a. *Concrete Sand.* For use in concrete pavements, bridge decks, precast pavers, or any other item used in concrete highway wearing surfaces, sand (natural or manufactured) must contain at least 25.0% acid-insoluble residue in the plus No. 30 size fraction and in the minus No. 30 size fraction. Sands may be blended to meet this requirement.

b. *Type 1 Coarse Aggregate.* Use coarse aggregate meeting one of the of the following requirements:

- Sandstone, granite, chert, traprock, ore tailings, slag, or other similar noncarbonated materials.
- For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 90.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
- For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 90.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

c. *Type 2 Coarse Aggregate.* Use coarse aggregate meeting one of the following requirements:

- Limestone, dolomite, or a blend of the two, having an acid-insoluble residue content not less than 20.0%.
- Sandstone, granite, chert, traprock, ore tailings, slag, or other similar noncarbonate materials.
- For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
- For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

*d. Type 3 Coarse Aggregate.* Use coarse aggregate meeting one of the following requirements:

- Limestone or a blend of limestone and dolomite having an acid-insoluble residue content not less than 20.0%.
- Dolomite.
- Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
- For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
- For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

*e. Type 9 Coarse Aggregate.* Use coarse aggregate meeting the requirements of §501-2.02 B.1.b. Coarse Aggregate.

**C. Admixtures.** Use only admixtures which meet the requirements of §711-08, or §711-13, and which appear on the Department's Approved List of Materials. Admixtures which do not conform to these requirements are subject to evaluation by the Materials Bureau.

**501-2.03 Concrete Batching Facility Requirements.** Batching facilities must be of sufficient design and capacity to produce the quantity of concrete specified. Batching facilities that differ from conventional designs will be considered for use by the Director, Materials Bureau.

**A. Acceptance.** Each facility requires initial and annual approval by the Director, Materials Bureau. The Regional Director may disapprove use of a previously approved facility at any time for non-conformance with the specifications. Once disapproved, production for Department work will not be allowed until corrective measures are implemented under the approval of the Regional Director.

**A. Bins.** Each facility requires:

- Sufficient size and number of storage bins to produce the quantity of concrete specified.
- Positive separations between fine aggregate and various sizes of coarse aggregates.
- Separate cement, pozzolan, High Reactivity Pozzolan, and microsilica bins, except Type I and

Type II cement may be combined in common storage unless the cement is intended for use in high sulfate or salt water areas as described in §501-2.02 A. Cementitious Materials.

- Cement, pozzolan, High Reactivity Pozzolan and microsilica bins with protection from rain and moisture.
- A means of safely obtaining uncontaminated samples from all microsilica bins.
- A means of safely obtaining uncontaminated samples from any cement, pozzolan or High Reactivity Pozzolan bin that has been determined by the Regional Materials Engineer as either unsafe to sample, or difficult to verify the acceptability of its contents.

Sampling will be conducted, or witnessed by the Regional Materials Engineer's representative.

**B. Weigh Hoppers and Discharge Chutes.** Each facility requires:

- Separate weigh hoppers for aggregate and cementitious materials.
- Enclosed cement weigh hopper to protect against moisture and reduce escaping dust.
- Chutes arranged so that materials will not lodge or be lost on discharge.
- No chutes suspended from any part of the weighing system.
- Vibrators arranged so that no significant vibrations are transmitted to the scales or other plant control equipment during the weighing process.

**D. Scales.** Each facility requires:

- Load cell type scales which indicate the load at all stages of the weighing operation, from zero to full capacity, when installed for weighing materials after January 2, 2003.
- Scales that meet the requirements of the National Institute of Standards and Technology, Handbook 44, with no less than 500 nor more than 2000 scale divisions.
- Digital displays that match the primary scale within 1 division.
- Minimum resolution of digital displays equivalent to the minimum resolution on the primary scale.
- Digital displays located in direct sight of the operator's normal work station.
- Face of digital displays protected from manipulation.

Test all plant scales for accuracy, at no additional cost, by a qualified technician as follows:

- Annually, prior to use for Department work.
- At intervals of not more than 90 calendar days.
- Whenever a plant changes location.
- At any time ordered by the Regional Director.

Provide a cradle or test platform approved by the Regional Materials Engineer, for each scale. Provide at least 20 certified 50 lb. test weights for performing scale accuracy tests. The certification of compliance for the test weights must be made available upon request at the time of the scale accuracy test. The use of a set of test weights for multiple facilities may be permitted, providing that the test weights are available for use within one hour after request. When directed by the Regional Director, protect the scales, and displays from manipulation by locking or sealing. Any evidence of tampering will be cause for rejection.

**E. Proportioning Control Equipment.** Proportion the materials by automatic proportioning devices approved by the Director, Materials Bureau. The Regional Director may require the locking or sealing of proportioning equipment that is subject to manipulation. Install automatic proportioning

equipment in a dust and weather protected area of at least 36 square feet, with no internal dimension less than 6 feet.

Include equipment to:

- Produce all batches in fully automatic mode using preprogrammed US Customary mix designs. The only manual operation allowed is a switch or button to start the batching sequence and/or discharge the completed batch.
- Accurately proportion the various components of the mixture by weight, or by volume for admixtures and water, in the proper order so that aggregates and cementitious materials are displayed cumulatively (when appropriate).
- Deliver each constituent within the tolerances indicated in Table 501-4, Batching Tolerances.
- Control the cycle sequence.
- Interrupt and stop the automatic batching operations via auxiliary interlock cutoff circuits, whenever an error exceeding the acceptable tolerance occurs in proportioning, for all materials except water.
- Time the mixing operations for central mix plants, and provide a clear indication on the recordation whenever the mix time has been interrupted.

Interlock the system so that during the batching of cementitious materials, aggregates and admixtures:

- No inlet gate can open while the weigh hopper discharge gate is open.
- No inlet gate can open while another material is being weighed in a shared weigh hopper.
- No weigh hopper discharge gate can open while the hopper is being filled nor until the full batch weight is within delivery tolerance.
- No new batch can be weighed until the hopper is entirely empty of the previous batch and the scale has returned to within the allowable zero tolerance.

**A. Admixture Dispensing Systems.** Equip plants with calibrated systems that meet the following:

- A sufficient number of dispensing systems to supply the concrete mixture specified.
- The ability to dispense each admixture through its own measuring system.
- Accurate measurement within the tolerance limits specified in Table 501-4, Batching Tolerances.
- A bypass valve to obtain a calibrated sample of admixture from each measuring device.
- Uniform distribution of admixture throughout the mix within the specified mixing period.
- When multiple admixtures are added, no direct contact with each other prior to mixing.
- An approved automatic admixture dispensing system in plants equipped with automated proportioning systems.
- Volumetric measuring devices interlocked with the automated proportioning equipment that insure the preset quantity has been actually measured and completely discharged.
- A readable indication at the operator's normal work station of the actual quantity batched.

Interlock the admixture system with the automated proportioning system so that aggregate and/or cement weigh hopper discharge gates cannot be opened until the preset quantity of admixture has been batched or discharged.

Recordation of the presence of admixture is dependent on completion of admixture discharge.

**G. Recordation Equipment.** Equip all plants with digital recording instruments approved by the Director, Materials Bureau, that meet the following requirements:

- Is readily accessible and readable at the operator’s normal work station.
- Provides separate quantity recordation of each aggregate component, cement, pozzolan, High Reactivity Pozzolan, microsilica , admixture, fine aggregate moisture content, and water (at central mix plants) for each batch of concrete. Water at central mix plants may be recorded by weight or volume.
- Records the batch number, concrete class, date (day, month, year), and time of day to the nearest minute on each batch record.
- Provides cumulative recordation (when batching cumulatively) of weight and/or volume as indicated on the batching scale or meter within an accuracy of  $\pm 1$  scale or meter graduation.
- Has a minimum recorder resolution equivalent to or less than the minimum graduation on the scale or meter, unless otherwise approved by the Director, Materials Bureau.
- Provides a clear and legible copy of all batch records, containing permanent identification of the time and all quantities in each batch, to the Department.
- Automatically stamps the date and time of batch completion on each batch and /or delivery ticket.
- Provides clear identification on batch recordation when:
  - ◆ Initiating a batch without all conditions satisfied for full automated production.
  - ◆ An out of tolerance condition is accepted during batching.
  - ◆ A system is taken out of the full automated mode during the batching sequence.
  - ◆ A system produces a “demonstration” or “simulated” batch.
  - ◆ A system reprints a batch ticket.
  - ◆ The timing of a central mixer has been interrupted.

When the automation system can produce other than standard size batches (full, half or quarter cubic yard increments), recordation will be subject to approval of the Director, Materials Bureau.

**H. Inspection Facility.** Provide a weatherproof building or trailer, for use as an inspector's testing laboratory and office that meets the following criteria:

- Meets all applicable uniform fire prevention and building code requirements.
- Office area partitioned from the testing laboratory.
- Minimum gross area of 160 square feet, a minimum internal width of 7 feet and a ceiling height of not less than 7 1/2 feet.
- Protected from a noise level greater than an 8 hour, time weighted average of 85 dBa.
- Laboratory area with tables, work benches, shelving, and other equipment for testing portland cement concrete mixes.
- Increase the area proportionally to house and operate any additional testing equipment, and when there are multiple plants at one site, size the increase of the laboratory and office space to be adequate for performing inspection duties during all production circumstances.

Use the inspection facility only for its intended purpose, and when the inspection facility is used by more than one inspection authority, the Department will have priority. The facility and its location are subject to approval by the Regional Materials Engineer. Maintain the inspection facility, office, and testing equipment in good operating and clean condition. The Producer will be responsible for routine cleaning.

Equip the inspection facility with the following:

**1. Office Equipment.** A Standard size (approx. surface dimensions: 30 x 60 inches) office desk with drawers and a chair, and a fireproof file cabinet with at least two locking drawers and two keys.

**2. First Aid Equipment.** An adequately stocked first aid kit at the plant site including:

- An emergency eye wash station in the laboratory area.
- Safety equipment including gloves, dust mask, etc..

**3. Sanitary Facilities.** A flush type toilet at the plant site, enclosed in a properly vented, separate room and complying with applicable sanitary codes. A portable toilet may be substituted when a facility is set up on a temporary basis for a specific project.

**4. Lighting.** Electric, non glare, providing a minimum illumination level of 1000 lux at desk and work bench level.

**5. Laboratory Sink / Potable Water.** A Sink and faucet with an adequate supply of clean water for testing, and if necessary, a water cooler for potable drinking water.

**6. Heating and Cooling.** Adequate heating and air conditioning equipment to maintain an ambient temperature of  $70\pm 5^{\circ}\text{F}$ .

**7. Ventilation.** Minimum 3.5 cfs exhaust hood, vented to the atmosphere, located over the sample drying area.

**8. Communication Equipment.** A telephone with a dedicated line in the laboratory office and a fax machine at the inspection facility or plant site for the inspector's use.

**9. Fire Extinguisher.** A 10 pound capacity multi-class ABC fire extinguisher, maintained and located in the laboratory area.

**10. Coarse Aggregate Sieve Shaker.** Power driven, with a minimum clear sieve area of 324 square inches.

- Anchored to a firm base.
- Imparts a vertical, or lateral and vertical motion.
- Equipped with an automatic timing shut-off device and dust cover.
- Fully enclosed and weatherproof when located outside the inspection facility.

**11. Fine Aggregate Sieve Shaker.**

- Power driven, independent of the coarse aggregate shaker.
- For 8 inch minimum diameter sieves.
- Imparts a vertical, or lateral and vertical motion.
- Equipped with an automatic timing shut-off device.
- Fully enclosed and weatherproof when located outside the inspection facility.

**12. Sample Splitter.** Able to split samples with a particle size of 1/2 – 2 inches.

**13. Large Scale.** Minimum capacity of 14 kg, with a maximum gradation of 0.005 kg meeting AASHTO M-231 Class G20. Scales provided as new or replacement after September 1, 2004, must be digital.”



**14. Small Scale.** Minimum capacity of 1500 g, with a maximum gradation of 0.1 g meeting AASHTO M-231 Class G2. Scales provided as new or replacement after September 1, 2004, must be digital.

**15. Sample Drying Appliance.** Stove or hot plates sized to rapidly dry aggregate samples with a minimum total of four burners.

**16. Miscellaneous Testing Equipment.** Miscellaneous equipment as per Department written directives or as requested by the Regional Director.

**17. pH Test Kit.** pH test kit meeting the requirements of Materials Procedure NY 90-1 for all plants supplying concrete containing microsilica (711-11).

**501-2.04 Concrete Mixer and Delivery Unit Requirements.** Each mixer requires a Manufacturer's plate, which contains the mixing capacity of the mixer, in a convenient visible location. Repair or replace blades inside the drum that have become heavily encrusted with mortar, or are loose, broken, bent, scalloped or worn 20% in any dimension or otherwise damaged.

**A. Central Mixers.** Central mixers meeting the following may be used unless otherwise specified:

- Equipped with an acceptable timing device that prohibits a batch of concrete from being discharged before the specified mixing time has elapsed (as per §501-3.03 C) without a clear indication on the recordation equipment.
- Able to discharge the entire batch in an unrestricted manner into a hopper or delivery unit.

**B. Delivery Units.** Delivery units are subject to inspection as per NYSDOT Materials Method 9.1 and approval by the Regional Director. If found unfit, it will be disapproved until properly repaired. Completely clean and empty the agitating and non-agitating units of concrete and wash water before loading again.

**1. Truck Mixer Requirements.** Use an inclined axis rotating drum type with a water tank system able to measure water (gallons) going into the drum within a 2% accuracy, and equipped with a hatch in the drum periphery to permit access to inspect the inside.

Each truck mixer unit will be inspected and approved annually by the Regional Materials Engineer for use in Department work, and additional inspections will be made during use to determine its operating condition. Truck mixers will not be permitted to mix batches greater than the maximum capacity indicated on the Manufacturer's rating plate.

**a. Transit Mixed Concrete.** Equip each truck mixer used for transit mixed concrete with an electrical revolution-counting device, appearing on the Approved List, mounted in a clearly visible position as follows:

- Separate counters showing; The number of drum revolutions at speeds within the mixing range and the total number of drum revolutions.
- Both counters legible to one revolution and designed to accept a non-standard electric plug for resetting each counter to read zero when loading at the batch plant.
- Tamper-proof such that if tampering occurs, the counters will become inoperative or the device will otherwise indicate tampering, including the interruption of electric power.
- Installed to count the number of revolutions of the drum only in the direction of mixing.
- Adjusted so that it counts the number of revolutions specified for the mixing and agitating drum speed within the tolerances indicated on the Manufacturer's rating plate, but not to exceed the following Department's requirements for truck mixers:

- ◆ Mixing - 6 RPM minimum to 18 RPM maximum
- ◆ Agitating - 2 RPM minimum to 6 RPM maximum
- ◆ The mixing and agitating revolution limits may be adjusted for individual mixing units upon approval of the Director, Materials Bureau.

*b. Central Mixed or Truck Mixed Concrete.* Equip each truck mixer used for central or truck mixed concrete, either as described in §501-2.04 B.1.a., for Transit Mixed Concrete, or as follows:

- Mixing speed capability - 6 RPM minimum to 18 RPM maximum.
- Agitating speed capability - 2 RPM minimum to 6 RPM maximum.
- Approved counter- located in a position readily visible to the Engineer that accurately counts the number of revolutions in the direction of mixing.

*2. Non- Agitating/Open Haul Units for Central Mixed Concrete.* Each truck shall be:

- Sound and watertight enough to prevent loss of material during delivery.
- Free of contamination.
- Covered to protect the concrete from adverse drying or precipitation, when ordered by the Engineer.

*C. Mobile Concrete Mixing Units.* A mobile concrete mixing unit, with the Engineer’s approval, may be used for miscellaneous work such as curb, gutter, headwalls, catch basins, manholes, drop inlets, field inlets, sign foundations, lighting structure foundations, anchor units, pullboxes, leveling footings and similar placements.

Equip the mobile mixing unit with proportioning devices that deliver the materials within the following tolerances by weight:

Cement	0 to +4%	Admixtures	±3%
Fine Aggregate	±2%	Water	±1%
Coarse Aggregate	±2%		

Use a self contained, continuous mixing type, that meets the following:

- Carries unmixed dry bulk cementitious materials, fine and coarse aggregate, water and admixtures sufficient for at least 6 cubic yards per batch, unless otherwise approved by the Regional Materials Engineer.
- Measures the amount of cement being introduced into the mix by a clearly visible meter which is kept clean at all times.
- Records the quantity of cement by a ticket printer that, as a minimum, records the number of revolution counts of the cement feeder.

*1. Water system*

- a. Provides positive control of the water flow into the mixing chamber.
- b. Water flow indicated by a readily adjustable flow-meter to provide for minor variations in aggregate moisture.
- c. Equipped with a bypass valve or hose suitable to determine batching accuracy.

*2. Admixture System*

- a. Equipped with at least one admixture delivery system.

- b. Provides positive control of the admixture flow into the unit's mix water system.
- c. Flow-meters to control the amount of admixture added to the mix.
- d. Dispenses admixtures in a manner that provides uniform distribution throughout the concrete.
- e. Adds admixture in the amount necessary to achieve the required air content.
- f. Equipped with a bypass valve to obtain a calibrated sample to determine batching accuracy.

**3. Mobile Mixing Unit:**

- a. Capable of combining aggregates, cement, water and admixture into a thoroughly mixed and uniform weight, and discharging the mixture without segregation.
- b. Set the mixing time to achieve proper and uniform mix, as determined by the Engineer.
- c. Stockpile all mix materials at the project site, unless otherwise approved by the Engineer
- d. Provide the necessary scales, containers and personnel, approved by the Engineer, to calibrate the unit.
- e. Calibrate the unit and provide a record of the calibration to the Engineer for the mix design to be used. The Regional Materials Engineer will furnish the mix design information and the calibration procedure. The Department reserves the right to witness calibration of the unit.
- f. Prior to actual use, demonstrate to the Engineer that the concrete meets the specification requirements for slump, air content and proportioning. Proportioning may be verified in accordance with NYSDOT Materials Method 9.4.

Correct any improper mixer conditions as approved by the Engineer. Improper conditions include, but are not limited to, blades that have become heavily encrusted with mortar, or are loose, broken, bent, scalloped, or worn 20% in any dimension or otherwise damaged. The Engineer will discontinue use of a unit that performs unsatisfactorily.

**D. Small Mixing Units.** The Engineer may allow a small construction mixer to mix small quantities of concrete. Mix for at least 90 seconds after all materials are in the mixer, and the Engineer will test the concrete for the specified slump and air content.

**501-3 CONSTRUCTION DETAILS**

**501-3.01 Proportioning.** Proportion all ingredients, except for admixtures, according to Table 501-3, Concrete Mixtures and as determined by the Department unless otherwise indicated in the contract documents. Any concrete mix design not meeting the requirements of Table 501-3 will be subject to approval by the Director, Materials Bureau.

**A. Aggregates and Cementitious Materials.** Aggregate and cementitious material proportions are indicated in Table 501-3, Concrete Mixtures, for standard classes of concrete. Mixes containing aggregate other than those permitted by §501-2.02B, Aggregates, are subject to approval by the Director, Materials Bureau.

Certain aggregates appear in the Approved List of Sources of Fine & Coarse Aggregates that have use limitations if combined with a high-alkali portland cement. The Regional Materials Engineer may allow the use of these aggregates in combination with high-alkali cements provided that pozzolans are substituted for cement in the following way:

TABLE 501-3A POZZOLAN SUBSTITUTIONS		
Concrete Class Specified	Substitute Cement by Mass With	Class Substitution Allowed
A, C, E, H	15-20% Class F Fly Ash (711-10)	HP <sup>1</sup>
I, J	15-20% Class F Fly Ash (711-10)	-

D	15-20% Class F Fly Ash (711-10)	DP <sup>1</sup>
G <sup>2</sup> and GG <sup>2</sup>	20% Class F Fly Ash (711-10)	-
F	No Substitution Allowed	-

**NOTES:**

1. Class HP and DP concrete may be substituted to mitigate ASR as listed above. Classes HP and DP require the replacement of portland cement with 20% pozzolan and 6% microsilica. The pozzolan may be either Class C or F Fly Ash (§711-10) or Ground Granulated Blast Furnace Slag (§711-12).
2. Classes G and GG require the replacement of portland cement with 20% pozzolan. The mitigation of ASR in Classes G and GG must be accomplished using Class F Fly Ash (§711-10).

Notify the Regional Materials Engineer prior to using pozzolan substitutions to mitigate ASR when using reactive aggregates in combination with a high alkali cement.

Approval may be withdrawn when unsatisfactory results occur.

**B. Admixtures.** Admixtures are used to achieve the desired set retardation, water reduction, slump, air content, and to protect reinforcing steel from corrosion. Admixtures are not considered part of the solid volume in the concrete mixture. The admixture manufacturer's recommended maximum dosage rate should not be exceeded to obtain the desired results as specified in Table 501-3.

**1. Air Entrainment.** Air entraining agent is required for all mixes to produce concrete with an air content in the range specified in Table 501-3, Concrete Mixtures unless otherwise indicated in the contract documents. The Engineer will test the concrete for plastic air content, and reject concrete with air contents outside the specified limits.

**2. Retardation.** The setting time of concrete may be retarded when necessary for proper placement. A water-reducing and retarding admixture (§711-08, ASTM Type D), is required in Class DP for Structural Slab Overlays (Section 584), Class HP for Superstructure Slabs and Structural Approach Slabs (Section 557), Class G and Class GG concrete. It may be used with, or in place of, a water-reducing admixture (§711-08, ASTM Type A) in other applications that allow Class DP or Class HP. Limit the use of the water-reducing and retarding admixture to the minimum amount required to achieve retardation during placing conditions. Unless otherwise specified, the use of water-reducing and retarding admixtures are subject to approval of the Regional Director.

**3. Water Reduction.** Unless otherwise specified, a water-reducing admixture (§711-08, ASTM Type A), is required in Classes DP, HP, I and J concrete. For all other classes, except G and GG, a water-reducing admixture may be used, subject to advance notification and approval of the Regional Materials Engineer.

High Range Water-Reducing Admixtures (§711-08, ASTM Type F), may not be used unless allowed by specification, plans, or the Director, Materials Bureau.

**4. Corrosion Inhibitors.** Corrosion Inhibitors, meeting the requirements of §711-13, may be used in special applications where specified in the plans, contract documents, or as directed by the Director, Materials Bureau.

**C. Water.** Add water to obtain the slump desired by the Engineer, within the Design Mix Guidelines of Table 501-3, Concrete Mixtures. The Engineer will test the concrete for slump, and reject concrete with a slump greater than the guidelines for use in Department work.

Concrete with insufficient slump may be adjusted to within the guidelines of §501-3.03 by adding water and remixing, when permitted by the specifications or the Engineer.

**D. Pozzolan.** Up to 20% of the cement content for Classes A, C, D, E, H, I, and J may be substituted with a pozzolan (Fly Ash or GGBFS), except where prohibited by the Regional Director. No additional pozzolan is permitted in Classes DP, G, GG, or HP. No pozzolan is permitted in Class F.

**E. Microsilica.** Microsilica meeting the requirements of §711-11 may be added as part of a Blended Cement (§701-03, Type SF or Ternary Blend) or batched independently as a powder.

**F. High Reactivity Pozzolan (HRP).** When permitted by Regional Materials Engineer, HRP meeting the requirements of §711-14 may be batched independently as a partial replacement for Portland cement in specialized or high performance mixes.

<b>TABLE 501-3 CONCRETE MIXTURES</b>							
<b>Design Mix Guidelines (where sand fineness modulus = 2.80)<sup>1</sup></b>							
<b>Concrete Class</b>	<b>T.C.M.<sup>5</sup> Content (lb/cy)</b>	<b>Sand % Total Agg. (solid volume)</b>	<b>Water/cementitious mat'ls (by weight)</b>	<b>Air Content % desired (Range)</b>	<b>Slump Range (in)</b>	<b>Type of Coarse Aggregate Gradation</b>	<b>Primary Use</b>
A	606	36.2	0.46	6.5 (5.0 - 8.0)	2 1/2 - 3 1/2	CA 2	general purpose structural
C <sup>6</sup>	605	35.8	0.44	6.5 (5.0 - 8.0)	1 - 3	CA 2	Pavement: slipform paving, form paving
D	725	45.8	0.44	7.5 (6.0 - 9.0)	2 1/2 - 3 1/2	CA 1	thin structural applications
DP <sup>2</sup>	725	45.8	0.40	7.5 (6.0 - 9.0)	3 - 5	CA 1	thin structural applications, overlays
E	648	35.8	0.44	6.5 (5.0 - 8.0)	3 - 4	CA 2	structural slabs and structural approach slabs
F	716	34.6	0.38	6.5 (5.0 - 8.0)	2 - 3	CA 2	high early strength for pavement or structural applications
G <sup>3</sup>	727	45.0	0.45	6.0 (4.0 - 8.0)	6 - 7	CA 2	underwater
GG <sup>3</sup>	800	45.0	0.45	6.0 (4.0 - 8.0)	6 - 7	CA 1	underwater (special)
H	675	40.0	0.44	6.5 (5.0 - 8.0)	3 - 4	CA 2	pumping applications
HP <sup>2</sup>	675	40.0	0.40	6.5 (5.0 - 8.0)	3 - 5	CA 2	pumping, structural slabs, approach slabs, substructures exposed to chlorides

I <sup>4</sup>	640	41.0	0.44	6.0 (4.0 - 8.0)	1/2 - 1 1/2	CA 2	slip forming highway median barriers
J <sup>4</sup>	680	45.8	0.44	6.0 (4.0 - 8.0)	1/2 - 1 1/2	CA 1	slip forming structural median barriers, parapet walls and curbs

**NOTES :**

1. Mixture proportions will be computed by the Regional Materials Engineer using the fineness modulus and bulk specific gravities (saturated surface dry) of the aggregates proposed for use.
2. Class DP and HP require the replacement of portland cement with 20% pozzolan and 6% microsilica and the addition of a water reducing admixture and / or water- reducing and retarding admixture. Refer to §501-3.01 B, Admixtures.
3. Class G and GG require the replacement of portland cement with 20% pozzolan, and the addition of a water- reducing and retarding admixture. Refer to §501-3.01 B, Admixtures.
4. These mixes require the use of a water reducing admixture. Refer to §501-3.01 B, Admixtures.
5. T.C.M. = Total Cementitious Material.
6. Slump range for slipform paving is 1 – 2 1/2 inches and for fixed form paving is 1 1/2 – 3 inches.

**501-3.02 Handling, Measuring and Batching Materials.** Arrange the batching facility and equipment to assure a continuous supply of material to the work.

When written approval is granted by the Director, Materials Bureau, bagged material may be incorporated into the mix. Adjust the batch size to use whole bags of bagged material. The handling, measuring and batching of bagged material must be verified and documented by a Department representative.

**A. Stockpiles.** Build good draining bases for stockpiles, at the batching facility, on prepared aggregate, concrete, metal or wood surfaces, or barge floors, subject to approval by the Regional Director. Build the stockpiles by methods which do not cause particle segregation. Stockpile all aggregates separately, by source and size so that no cross contamination occurs. Label all Department approved stockpiles by source number.

Handle aggregates throughout the batching process such as to maintain uniform grading of the material. In case the aggregates contain a high or non-uniform moisture content, stockpile the aggregates for a sufficient length of time to stabilize the moisture content.

Equip each plant with a moisture sensing device that indicates, on a readily visible scale or chart, the fine aggregate moisture content as it is batched. Indicate the free moisture content on the batch recordation during batching. The free moisture content during batching is limited to a maximum of 8% of the fine aggregate’s saturated-surface dry weight.

The Regional Materials Engineer will determine the acceptability and accuracy of the moisture sensing device. If the device is considered accurate, the free moisture content of the fine aggregate may be allowed to be adjusted between batches based on the most recent moisture reading. No adjustment for free moisture will be allowed for an individual batch after batching starts.

**B. Heating Materials for Cold Weather Concreting.** Use equipment that uniformly heats the materials. To obtain the specified temperature of the plastic concrete when the air temperature is below 32°F, heat the aggregates by steam or dry heat and heat the mix water. When the air temperature is 32°F or more, and the aggregates are free of ice, the specified temperature may be obtained by heating only the mix water. The equipment and operations for heating the materials must be approved by the Regional Director prior to use on Department projects.

Specified Temperature Range	Minimum	Maximum
Mix Water	70°F	180°F
Aggregate	40°F	100°F

Plastic Concrete in place                      50°F                      70°F

To avoid the possibility of flash set when water is heated over 100°F, combine the water and aggregate in the mixer so that the water temperature is reduced before cement is added.

**C. Batching.**

**1. Aggregates.** When sizes are weighed cumulatively, allow a  $\pm 2\%$  tolerance for each draw weight, based on the combined aggregate batch weight. If sizes are weighed separately, apply the tolerance to each scale weight.

**2. Cement and Pozzolan.**

*a. Batching without microsilica or HRP added independently on a common scale.* Weigh the cement, blended cement, or pozzolan cumulatively with a  $\pm 1\%$  tolerance for each draw weight (based on the combined weight of all cementitious materials). Weigh the pozzolan last in the weighing sequence.”

*b. Batching with microsilica or HRP added independently on a common scale.* Weigh all cementitious materials cumulatively with a  $\pm 0.5\%$  tolerance for each draw weight (based on the combined weight of all cementitious materials). Double the minimum allowable batch weight. Weigh the microsilica or HRP last in the weighing sequence.

**3. Microsilica and High Reactivity Pozzolan (HRP).**

*a. Batching with cement, Type IP or SM blended cement, or pozzolan on a common scale.* Weigh the microsilica or HRP cumulatively with a  $\pm 0.5\%$  tolerance for each draw weight (based on the combined weight of all cementitious materials). Double the minimum allowable batch weight. Weigh the microsilica or HRP last in the weighing sequence.

*b. Batching microsilica or HRP on a separate scale.* Weigh the microsilica or HRP with a  $\pm 1\%$  tolerance (based on the total weight of microsilica or HRP).

**D. Delivery Tickets.** Each delivery ticket must contain the following:

- SiteManager Mix ID
- Delivery Ticket Number
- Plant Identification, with plant name and location and/ or facility number
- Contract Number
- Concrete Class or Item Number
- Quantity (Nominal Batch Size)
- Truck Number
- Batch Number
- An Automatically Applied Time- Date Stamp (immediately upon completion of batching) which may consist of one of the following :
  - ◆ Time - Date stamp by separate printing device on a regular ticket
  - ◆ Time - Date printed by a batch weight recorder on a printed ticket.
  - ◆ Time - Date printed by a batch weight recorder on a printed tape. Affix a copy of the tape to the regular delivery ticket.

**E. Failure of Automatic Batching, Admixture Dispensing and Recording Equipment.** If automatic proportioning, admixture dispensing or recording instruments fail, the plant may be allowed, subject to approval of the Regional Director or his representative, to continue producing concrete for the Department for up to 48 hours from the time of breakdown. Written permission of the Regional Director will be required to operate without these instruments for periods longer than 48 hours.

During this period, batch all materials within the automatic proportioning system tolerances.

<b>TABLE 501-4 BATCHING TOLERANCES<sup>3</sup></b>	
Cement, Pozzolan, or Blended Cement	± 1% (by weight) of total cementitious materials, if no microsilica or HRP is weighed cumulatively on a common scale.
	± 0.5% (by weight) of total cementitious materials, if microsilica or HRP is weighed cumulatively on a common scale.
Microsilica or HRP	± 0.5% (by weight) of total cementitious materials, if weighed cumulatively with any other cementitious material.
	± 1% (by weight) if weighed on a separate scale.
Aggregates	± 2% (by weight)
Water <sup>1</sup>	± 1%
Admixtures (711-08, or 711-13)	± 3% by volume, or ± 1 meter pulse, whichever is greater.
Admixtures (others)	Contact Director, Materials Bureau
Zero - Aggregate <sup>2</sup>	± 2%
Zero - Cementitious Materials <sup>2</sup>	± 1%
Zero-Water (weighed) <sup>1,2</sup>	± 1%

- NOTES:**
- 1: Tolerance applies to water batched at central mix plants only.
  - 2: Zero tolerance applies to empty scales, based on the minimum allowable batch size.
  - 3. All tolerances are based on the pre-programmed target quantity.

**501-3.03 Concrete Mixing, Transporting and Discharging.**

**A. General.** Mix the concrete at a central mix plant, in truck mixers in transit or at the site. When mixed at a central mix plant, transport the concrete in vehicles acceptable to the Regional Director. Place the fresh concrete directly into the forms or into conveyance equipment approved by the Regional Director before evidence of initial set. No water addition will be permitted after the mix has reached the mid-point of the slump range, as indicated in Table 501-3, Concrete Mixtures, for the class used. Concrete with a discharge temperature exceeding 90°F will be subject to rejection.

Notify the Regional Materials Engineer’s office by 3:00 PM on the day before any production for the Department. Supply fresh concrete at a rate consistent with placement operations as determined by the Engineer. The Regional Director may disapprove the use of any type of concrete mixing or transporting units when unsatisfactory results occur.

Load the mixer, regardless of type, in a manner approved by the Regional Director and mix batches of concrete no larger than the rated capacity shown on the Manufacturer’s plate.

A summary of time limitations for various types of concrete mixing equipment, from the beginning of batching to the completion of discharge, is given in Table 501-7, Summary of Concrete Batching, Mixing, Hauling and Discharging.

**B. Concrete Uniformity.** Use a mixer that combines aggregates, cementitious materials, water and admixtures into a uniform weight within the specified time. The mixer is required to discharge the mixture without segregation, and meet the uniformity requirements in Table 501-5, Concrete Uniformity. The Department will perform tests when required by the specifications or requested by the Regional Director.

It will only be necessary to verify that mixing equipment meets uniformity requirements if evidence of non-uniform concrete is found or a reduced mixing time for central mixers is requested.



A reduction in the batch size below the rated mixer capacity or reduced mixing speed tolerance limits may be required to obtain uniformity.

<b>TABLE 501-5 CONCRETE UNIFORMITY</b>		
<b>Test</b>	<b>Permissible Variation (Concrete samples taken at two locations in the batch)</b>	
Weight per cubic foot calculated to an air-free basis	2.0 lb/cf	
Air Content, % by volume of concrete	1.0%	
Slump:	Average slump 4 in or less	1 in
	Average slump greater than 4 in	1 1/2 in
Coarse aggregate content, portion by weight of each sample retained on a No. 4 sieve	6.0%	
Unit weight of air-free mortars based on average for all comparative samples tested	1.6 %	

**NOTE:** The Department will take samples at the mixer discharge point and test in accordance with Materials Method 9.2.

**C. Central Mixed Concrete.** Central mixed concrete is concrete mixed in a stationary mixer and transported in approved agitating or non-agitating delivery units to the deposition point. Use a minimum 90 second mixing time after all materials are in the drum, unless tests show that the requirements of Table 501-5, Concrete Uniformity, can be consistently obtained at a lesser time as approved by the Director, Materials Bureau.

Use delivery units that transport thoroughly mixed concrete without loss of uniformity meeting the requirements of §501-2.04B.1.b. or §501-2.04B.2., pertaining to Central Mixed Concrete.

Travel on a haul road free from holes, washboarding or other features that cause segregation in plastic concrete.

Do not exceed the time limit between completion of mixing at a central mix plant and completion of discharge as noted in Table 501-6, Time Limits for Delivery of Central Mixed Concrete.

When transporting central mixed concrete in units approved for truck mixing, add a minimum of 90% of the design water to the mix with the batch plant water system.

Two additions of water will be allowed at the discharge point to obtain initial slump. After each addition, mix the concrete at least 30 mixing-speed revolutions before discharging. The initial loads may, with prior written approval by the Regional Materials Engineer, also be adjusted by using a water-reducing admixture (711-08, ASTM Type A). This adjustment will be limited to the first trucks arriving for a particular placement before any adjustments have been made at the batching facility. Observe the maximum number of mixing revolution or water addition requirements. Make all subsequent admixture additions or adjustments during production at the batching facility. No additions or adjustments are allowed when non-agitating / open haul units are used.

<b>TABLE 501-6 TIME LIMITS FOR DELIVERY AND DISCHARGE OF CENTRAL MIXED CONCRETE</b>	
<b>Delivery Unit</b>	<b>Maximum Time (Minutes)</b>
Non-Agitating / Open haul	30
Agitating - rotating drum	90 *

\* The Engineer will reject the concrete if there is evidence of initial set, and may reduce the time limit in hot weather or under unusual conditions if unsatisfactory results occur. For concrete that does not contain a water-reducing and retarding admixture, the time to initial strike-off or placement of subsequent lifts is included in the delivery and discharge time limit.

**D. Transit Mixed Concrete.** Transit mixed concrete is concrete batched at the production facility and mixed completely in a truck mixer at the following locations or combinations thereof: the plant, while in transit, or the discharge point. Transit mix may be used for all concrete items unless otherwise specified. Use a truck mixer meeting the requirements of §501-2.04B.1.a., pertaining to Transit Mixed Concrete.

- Load the mixer as follows:
1. Totally drain the drum of wash water before loading.
  2. Revolve the drum while loading the mix ingredients and add approximately 90% of the design water.
  3. Begin mixing within 5 minutes of cement to aggregate contact .

TABLE 501-7 SUMMARY OF CONCRETE BATCHING, MIXING, HAULING AND DISCHARGING			
Central Mixed Concrete	Transit Mixed Concrete		Truck Mixed Concrete
<b>Begin Batching</b>	<b>Begin Batching</b>		<b>Begin Batching</b>
Load mixer	Hatch load, or ribbon load materials through barrel hopper.		<b>REGULAR MIX</b> Load aggregates. Drum may be rocked or revolved
<b>End of Batching and Begin Mixing</b>	Add approx. 90% of design water		<b>LAYERED MIX</b> Load fine agg. , then SSD coarse agg. through hatch Drum may be rocked.
90 Second minimum after all materials are in the mixer.	▲	<b>Cement In Contact With Aggregates</b> 5 Minutes max.	<b>Load Cement</b> (See Note 3)
<b>End of Mixing</b>		<b>Begin Mixing</b> at plant or in transit	<b>Cement In Contact With Aggregates</b> 30 Minutes max.
<b>Open Haul Units</b>	<b>Rotating Drum</b>		<b>Begin Mixing</b> At project, after adding water
	Agitate 2-6 rpm	<b>Class HP or Class DP</b> 100 rev. minimum 200 rev. maximum	<b>Class HP or Class DP</b> 100 rev. minimum 200 rev. maximum
30 Minutes maximum	90 Minutes maximum (See Note 2)		Mix: 6-18 rpm
<b>Completion of Discharge</b>	90 Minutes max. (Note 2)	<b>All Other Classes</b> 100 rev. minimum 160 rev. maximum	<b>All Other Classes</b> 100 rev. minimum 160 rev. maximum
(When concrete is transported in units approved for mixing, see Note 1)		Mix: 6-18 rpm	15 Minutes maximum
		<b>End of Mixing</b> Agitate 2-6 rpm	<b>End of Mixing</b> Agitate 2-6 rpm
		<b>Begin Discharge</b>	<b>Begin Discharge</b>
		50 Minutes maximum	30 Minutes maximum
	▼	<b>Completion of Discharge</b>	<b>Completion of Discharge</b>

**NOTES:**

1. The remainder of the design water may be added at the work site to attain initial slump. When approved by the Regional Materials Engineer, only the first trucks may be adjusted to obtain initial slump using a water-reducing admixture (711-08, ASTM Type A). Exceeding the maximum mixing revolutions or water addition requirements will not be permitted.
2. For mixtures that do not contain a water-reducing and retarding admixture (711-08, ASTM Type D), the 90 minute maximum time includes the time to initial strike-off, or placement of subsequent lifts.

3. Add cement through hatch. Do not move drum while cement is being added.

Mix for a minimum of 100 mixing- speed revolutions and then check for consistency. If the truck is en route to the project, change the speed from mixing to agitating after 100 mixing revolutions. Unless restricted by local traffic laws, do not stop the rotation of the drum during transit.

Two additions of water will be allowed to obtain initial slump at the discharge location . After each addition, mix at least 30 mixing speed revolutions. For Class DP or HP concrete, mix a total of 100 to 200 mixing speed revolutions. For all other classes of concrete, mix a total of 100 to 160 mixing speed revolutions.

The initial loads may, with prior written approval by the Regional Materials Engineer, also be adjusted by using a water- reducing admixture (§711-08, ASTM Type A). This adjustment will be limited to the first trucks arriving for a particular placement before any adjustments have been made at the batching facility. Observe the maximum number of mixing revolution or water addition requirements. Make all subsequent admixture additions or adjustments during production at the batching facility.

After mixing, either discharge the load immediately or revolve the drum at agitating speed. Once begun, discharge the entire load within 50 minutes.

For mixes containing a water- reducing and retarding admixture, the total time interval from the moment the cement makes contact with the aggregates to the completion of discharge shall not exceed 90 minutes.

For mixes that do not contain a water- reducing and retarding admixture, the total time interval from the moment the cement makes contact with the aggregates to the completion of initial strike off or placement of subsequent lifts shall not exceed 90 minutes.

The Regional Director may reduce the total time limit in hot weather or under unusual conditions, if unsatisfactory results are obtained.

**E. Truck Mixed Concrete.** Truck mixed concrete is concrete completely mixed in a truck mixer meeting the requirements of §501-2.04B.1.b. Truck Mixers, after adding water at the discharge location. Apply §501-3.03D. Transit Mixed Concrete, except as follows:

**1. Loading of Mixer:**

*a. Regular Truck Mix (cement in contact with moist aggregates).* The drum may be rocked or revolved while loading coarse and/or fine aggregates with admixtures. Load the cement last, while keeping the drum stationary. Begin mixing within 30 minutes of cement to aggregate contact.

*b. Layered Truck Mix (cement in contact with Saturated Surface Dry(SSD) or drier coarse aggregate).* Batch the fine aggregate with admixtures, coarse aggregate and cement all separately. Load these materials through a hatch in the side of the drum in the following sequence: fine aggregate with admixtures, coarse aggregate, and cement last. The drum may be rocked after adding each aggregate size, but kept stationary while loading the cement. Begin mixing within 90 minutes of cement to coarse aggregate contact.

**2. Mixing:** Begin mixing at the discharge location. Add water to the drum either from the head section or by dual injection from both the head and discharge end. Mix for a minimum 100 revolutions or until uniform concrete of the specified consistency is produced, whichever is longer. Do not exceed a 15 minute mixing period.

**3. Discharge:** Discharge the entire load within 30 minutes after mixing.

**501-4 METHOD OF MEASUREMENT.** The Engineer will compute the volume of concrete as the number of cubic yards within the payment lines indicated on the plans or as specified by the Engineer. No deductions will be made for the volume of embedded reinforcement, structural shapes or joint materials. Also, no deductions will be made in concrete pavement for catch basins, manholes, etc. unless otherwise indicated in the contract documents.

**501-5 BASIS OF PAYMENT.** Include the cost of furnishing all materials, equipment and labor necessary to complete the work in the unit price bid for the appropriate items.

**SECTION 502 - PORTLAND CEMENT CONCRETE PAVEMENT**  
(Last Revised May, 2019)

**502-1 DESCRIPTION.** Construct a Portland Cement Concrete (PCC) pavement and shoulders, if required, as detailed in the contract documents.

**502-2 MATERIALS**

Portland Cement Concrete	501
Chemically Curing Adhesive for Portland Cement Concrete (PCC) Pavement Applications	701-14
Highway Joint Sealants (ASTM D6690, Type IV)	705-02
Premoulded Resilient Joint Filler	705-07
Preformed Elastic Longitudinal Joint Seal	705-10
Preformed Elastic Transverse Contraction and Expansion Joint Seal	705-12
Lubricant for Preformed Elastic Joint Sealer	705-13
Longitudinal Joint Ties	705-14
Transverse Joint Supports	705-15
Wire Fabric for Concrete Reinforcement	709-02
Epoxy Coated Bar Reinforcement, Grade 60	709-04
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Polyethylene Curing Covers (white opaque)	711-04
Membrane Curing Compound	711-05
Form Insulating Materials for Cold Weather Concreting	711-07
Water	712-01

If requested, provide the Engineer with any appropriate manufacturer’s details and/or instructions for use of listed materials before use of the product.

In addition to meeting the requirements of §701-14, Chemically Curing Adhesive for Portland Cement Concrete (PCC) Pavement Applications, the material used to anchor longitudinal joint ties, dowels, or other miscellaneous items into hardened concrete must be a pourable, two-component, 100% solid structural epoxy dispensed:

- From side-by-side cartridges by manual or pneumatically powered injection guns.
- Through a static mixing nozzle that homogeneously mixes the material without any hand mixing.

**502-2.01 Concrete.** Use Class C concrete furnished in accordance with Section 501, Portland Cement Concrete – General, when specified. High-Early-Strength (HES) concrete, meeting the requirements of §502-2.02, may be substituted for closure or short placements, subject to the Engineer’s approval.

**502-2.02 High-Early-Strength (HES) Concrete.** Use HES concrete where required in the contract documents or where the Contractor’s request to use HES concrete is approved by the Engineer.

Whether required or requested, design the HES mix to satisfy the opening to traffic time requirements of the project and Table 502-1, High-Early-Strength Concrete Mix Requirements. Submit the HES concrete mix design to the Engineer. Include admixture brands and dosages as well as mixing, transporting, placing, paving, curing, and anticipated strength gain details.

Produce and place a 4.0 yd<sup>3</sup> (minimum) trial batch at an off-contract location selected by the Contractor and agreed upon by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce concrete for the contract. Provide the Engineer a 7-day minimum advance notification of trial batch production. Produce and place the trial batch in the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel.

Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to:

- Measure slump, air content, and unit weight of the trial batch.
- Cast cylinders from the trial batch for compressive strength and durability testing.

Determine the compressive strength of the trial batch concrete at the desired time as discussed in §502-3.16C, Project Strength Determination.

The Materials Bureau will render a decision on mix acceptability, curing, and opening to traffic requirements within 45 calendar days of trial batch production. Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer will reject the concrete if the specified plastic air content is not achieved. The Engineer may halt paving and order additional trial batches whenever the specified compressive strength requirements are not achieved.

<b>TABLE 502-1 HIGH-EARLY-STRENGTH CONCRETE MIX REQUIREMENTS</b>			
<b>Property</b>	<b>Minimum</b>	<b>Desired</b>	<b>Maximum</b>
28 Day Compressive Strength	4000 psi	-	-
Opening Compressive Strength	2500 psi <sup>1</sup>	-	-
Freeze-Thaw Loss (Test 502-3P, 3% NaCl)	-	0.0 %	3.0 %
Plastic Air Content	5.0 %	6.5 %	8.0 %
Water – Cement Ratio (w/c)	-	-	0.40
Slump <sup>2</sup>	-	-	-

**NOTES:**

1. See §502-3.16, Opening to Traffic.
2. There are no minimum or maximum requirements for slump, however mix must be fluid enough to finish without segregating.

**502-2.03 Performance Engineered Mixes (PEM).** If specified, design a concrete mixture proportioned to meet the requirements of the contract documents. Procedures for mix approval and acceptance will also be included in the contract documents.

**502-2.04 Load Transfer Dowel Bars.** Refer to 705-15 for Dowel bar requirements. If specified, load transfer dowel bars other than epoxy coated steel may be required. The material requirements as well as the approval and acceptance procedures will be included in the contract documents.

**502-3 CONSTRUCTION DETAILS.** Hold a pre-pave meeting 7 to 14 day before the planned start of paving with the Engineer, any PCC paving and saw cutting subcontractors, and concrete suppliers to coordinate all aspects of paving and inspection, including equipment review, construction methods, and time and personnel requirements.

Construct a smooth, well consolidated, properly finished, textured, and cured pavement to the line and grade depicted in the contract documents,  $\pm 1/4$  inch vertically at any location.

**502-3.01 Equipment.** Provide the Engineer with an equipment list and specifications a minimum of 14 days prior to the planned start of PCC paving. Bring all equipment needed to place, consolidate, finish, texture, cure, saw cut, seal, and test the PCC pavement to the job site a minimum of 1 full work day before its use to allow examination by the Engineer. Repair or replace any equipment found to be defective before or during its use. Discontinue any operation if unsatisfactory results are being obtained. Use of equipment other than described below is subject to the approval of the Director, Materials Bureau.

- A. Slipform Paving.** Use a self-propelled slipform paver equipped with:
- Rigid side forms that laterally support the concrete and minimize edge slumping.
  - A full-width finishing pan.
  - Attached internal vibrators capable of consolidating the entire concrete placement.

Slipform paving consists of a single paver, or a placer/spreader followed by a separate paver, capable of placing, spreading, consolidating, screeding, and finishing the concrete such that hand finishing is kept to a minimum. Use equipment guided by a reference system that ensures the pavement is placed to the specified line, grade, and cross section.

**B. Fixed Form Paving**

- 1. Forms.** Use straight forms without horizontal joints meeting Table 502-2, Form Requirements, and equipped with:
- At least 3 stake pockets spaced 3 feet apart (maximum), each having a positive, nondetachable wedge.
  - Positive, interlocking devices capable of holding abutting sections together to form neat, tight joints.

<b>TABLE 502-2 FORM REQUIREMENTS</b>	
<b>Characteristic</b>	<b>Requirement</b>
Material	Steel, 1/4 inch thick, minimum.
Length	10 feet, minimum.
Depth	Equal to the sum of the edge thicknesses of all pavement layers placed within the form.
Base Width	Equal to the depth, minimum.
Horizontal Top Face	2 inch wide, minimum, and lying in a plane with a maximum variation of 1/8 inch in 10 feet.
Vertical Face	Maximum variation of 1/4 inch in 10 feet and rounded on the upper corner with a 3/4inch radius, maximum.
Flange Bracing	Extends outward on the base 2/3 of the form depth, minimum.

Flexible, curved, or wooden forms may be used in irregular areas or curved sections having horizontal radii of 100 feet or less.

- 2. Paving Equipment.** Use fixed form paving equipment specifically made for placing concrete. The equipment must be capable of placing, spreading, consolidating, screeding, and finishing the concrete to the specified line, grade, and cross section such that hand finishing is kept to a minimum. Use equipment with either attached internal vibrators or in conjunction with hand-

held internal vibrators.

**C. *Vibrators.*** Use paver-mounted internal vibrators capable of consolidating the entire concrete placement that are:

- Capable of being shut off without shutting off the paver.
- Equipped with frequency controls readily accessible to the paver operator.
- Capable of simultaneously operating at the same frequency as the other paver-mounted vibrators.
- Capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute.

Check vibrator operating frequencies daily when paving begins. Check frequencies under load with the Engineer present. If the paver is not equipped with direct-read frequency gauges for each vibrator, supply the Engineer with a calibrated, hand-held tachometer, including instructions, to monitor vibrator frequencies. The tachometer will remain the Contractor's property after paving is complete.

Use hand-held vibrators capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute in any location that is not consolidated by internal vibrators attached to the paving equipment.

**D. *Saw Cutting Equipment.*** Use diamond blade saws capable of making straight cuts to the dimensions depicted in the Standard Sheets that are equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control.

Maintain equipment and supplies to ensure uninterrupted saw cutting. Early entry saws require approval from the Director, Materials Bureau. Submit requests to use early entry saws at least 7 calendar days before paving.

**E. *Curing Compound Applicators.*** Use atomizing mechanical sprayers capable of exerting consistent pressure without hand pumping that are equipped with tank agitators to continuously mix the curing compound. Use nozzles with spray shields to prevent drift. Flush nozzles daily before use.

Maintain equipment and supplies, including extra nozzles, to ensure uninterrupted curing compound application. In a multi-lane slip form paving operation, use self-propelled applicators guided by the same reference system as the slip form paver. Otherwise, applicators need not be self-propelled.

**F. *Drills.*** Use gang drills with a minimum of 2 independently powered and driven drills. Use tungsten carbide drill bits. Rest and reference the drill rig frame on and to the pavement surface such that the drilled holes are cylindrical, perpendicular to the surface being drilled, and repeatable in terms of position and alignment. Hand-held drills are permitted for drilling holes in longitudinal joints if there is not enough room to use gang drills resting on the pavement surface.

**G. *Joint Sealing - Highway Joint Sealant.*** Heat the sealant in a melter constructed either:

- As a double boiler with the space between inner and outer shells filled with oil or other heat-transfer medium.
- With internal tubes or coils carrying the sealant through a heated oil bath and into a heated double-wall hopper.

Do not use direct heating. Use a melter capable of maintaining the sealant's pouring temperature and providing homogeneous sealant equipped with:

- Positive temperature control.
- Continuous full sweep mechanical agitation.

- Separate thermometers indicating the temperatures of the heat transfer medium and the sealant in the hopper. Do not place any sealant if the thermometers are defective or missing.

Provide 2 thermometers having stems 18 inches long and temperature ranges sufficient to meet the requirements of this specification. Use a discharge hose equipped with a controlled heating apparatus or sufficiently insulated to maintain the proper sealant pouring temperature. Use nozzles that apply the joint sealant within the joint confines for the full width and depth of the joint.

**H. Air Blasting Equipment.** Use equipment with traps or other installed devices that prevent moisture and oil from contaminating the concrete surface. Use a compressor that delivers air at a minimum of 120 cfm and develops a minimum nozzle pressure of 90 psi. Check the compressed air stream purity daily with a clean white cloth.

### **502-3.02 Weather Limitations**

**A. Rain.** Do not pave in the rain. Supply sufficient quilted covers, plastic coated fiber blankets, or polyethylene curing covers near the paving operation when rain may be expected. Securely cover any concrete exposed to rain that has not reached initial set or will be visibly affected by the rain.

**B. Cold Weather.** Place concrete when the air temperature is 40°F and rising, or warmer, and when the surface temperature of the area to be paved is 40°F, or warmer. Stop paving when the air temperature falls below 40°F. Measure temperatures in the shade to an accuracy of 1°F. Refer to §502-3.11C, Cold Weather Curing.

**502-3.03 Subbase Course.** Install a subbase course in accordance with Section 304, Subbase Course, before placing PCC. If the area is available, extend the prepared subbase course at the same line, grade, and cross slope as the area being paved such that it is at least:

- 3 feet beyond the longitudinal edges of a slipform pavement.
- 1 foot beyond the outside longitudinal edges of the fixed forms.

Additional subbase course that is not included in the finished work will be paid for under Section 304 items included in the contract.

**502-3.04 Slipform Paving.** Establish a reference system to achieve the specified smoothness level. If string lines are used, set them by survey and use dual lines whenever possible.

Maintain uniform concrete quality and head in front of the paver. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep paver tracks clear of concrete and debris before and during paving.

Wet the entire subbase surface without forming puddles or mud immediately before placing concrete.

Consolidate the entire concrete placement using internal vibrators attached to the paver. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Determine edge slump by extending a 2 foot (minimum) long straightedge over the longitudinal pavement edges. Immediately correct edge slumps greater than 1/4 inch that are between concrete placements and greater than 3/8 inch at free edges and HMA shoulders.

### **502-3.05 Fixed Form Paving.**

**A. Setting Forms.** Compact the supporting layer at the form line such that the forms are supported for their full length. Set forms to string lines placed at the pavement elevation, line, and grade and to achieve the specified smoothness. If a form sits above the string line, remove the form and trim the



form line to the proper grade. If a form sits below string line, remove the form and fill and compact the low area with granular material at least 6 inches on both sides of the form. Frequently check form grade and alignment while paving. Reset forms as necessary.

Set forms to accommodate a full day's paving before placing concrete. Extend forms beyond construction bulkheads to provide a working platform at the end of a placement. Secure each form with a minimum of 3 pins, each of sufficient length to hold the forms in place without movement during any operation. Lock the forms together such that the form ends are aligned and the joints are tight and smooth. Run the paving equipment atop the forms before placing any concrete and recheck form alignment. Reset forms as necessary.

Align keyway strips in a smooth, horizontal plane, parallel to the top of the form. Match keyway strips on abutting forms such that a nearly seamless keyway results.

**B. Paving.** Apply oil to forms before placing concrete. Immediately before placing concrete, wet the entire subbase surface without forming puddles or mud. Uniformly distribute the concrete in front of the paver by maneuvering the delivery truck chute. If concrete is spread by hand, use come-alongs or shovels. Do not use rakes or hand-held vibrators to spread concrete.

Maintain uniform concrete quality and head in front of the paving machine and without running over the screeds. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep form tops clean before and during paving.

Consolidate the entire concrete placement using internal vibrators attached to the paver. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Use hand-held vibrators ahead of the paving equipment to consolidate all concrete not consolidated by machine-mounted internal vibrators. Keep hand-held vibrators perpendicular to the pavement surface. Vibrate between 2 and 4 seconds in each location, overlapping adjacent locations. Do not drag vibrators through the concrete. Do not walk through consolidated concrete.

Mark the midpoint ( $\pm 1/2$  inch) of each transverse contraction joint such that the saw cut operator can accurately locate the first-stage saw cut locations.

**C. Form Removal.** Remove forms after the concrete has developed sufficient strength to allow removal without damaging the pavement. Repair pavement damaged during form removal. Remove forms before making second-stage saw cuts.

**502-3.06 Joint Construction.** The Engineer will inspect the longitudinal joint ties and transverse joint supports for compliance to the relevant Materials Details before any joint hardware placement is allowed. Construct joints in accordance with the Standard Sheets and approved Materials Details. Do not stand on joint hardware.

Base final joint layout on construction staging and the actual location of utilities, drainage structures, intersections, tapers, and other irregular areas. Submit a proposed joint layout to the Engineer at least 10 calendar days prior to PCC paving. Obtain the Engineer's approval of the joint layout before paving.

Inserting dowels and/or longitudinal joint ties into plastic concrete will be considered. Submit a plan to verify dowel and tie locations, depth, and alignment to the Engineer for consideration. Do not insert dowels or ties until the plan is approved by the Engineer.

Make first-stage saw cuts 1/8 inch wide. Make second-stage saw cuts, clean, and seal joints in accordance with §502-3.12, Sealing Joints.

**A. Transverse Joints.** Transverse joints include contraction, expansion, hinge, and construction joints. Secure joint supports to the subbase as depicted in the Materials Details. Maintain joint supports in their proper position and alignment during paving.

Construct transverse joints perpendicular to both the pavement surface and longitudinal joints in the area being paved. Use a 15 foot maximum transverse joint spacing for pavements having standard slab widths of 12 to 13 feet. For pavements having other slab widths, determine typical maximum and minimum transverse joint spacing in accordance with the following:

$$L_{\max} = W_{\min} \times 1.33$$

$$L_{\min} = W_{\max} \div 1.33$$

where:

$L_{\max}$  = maximum transverse joint spacing (slab length)

$L_{\min}$  = minimum transverse joint spacing (slab length)

$W_{\max}$  = maximum slab width across the pavement (load carrying slabs only)

$W_{\max} \leq 13$  feet

$W_{\min}$  = minimum slab width across the pavement (load carrying slabs only)

**1. Transverse Contraction Joints.** All transverse joints are contraction joints unless otherwise shown in the contract documents. Contraction joints are constructed in a straight line across the full width of the PCC pavement and shoulders. Contraction joints may be angled (rather than straight across a pavement) at tied longitudinal joints between lanes placed separately if the placements do not have the same centerline, e.g., where a ramp centerline diverges from parallel to the pavement centerline. Contraction joints may terminate at, or be misaligned at, untied longitudinal joints as discussed in §502-3.06B3, Untied Longitudinal Joints.

Store transverse contraction joint support assemblies in inverted stacks at the project site. Cover stored epoxy coated steel such that it is protected from direct sunlight. Handle joint supports such that no twisting or bending occurs during storage and positioning. Supports with bent, twisted, or deformed wires will be rejected.

Before placing concrete, position transverse joint supports such that the:

- Entire longitudinal axis of each dowel is located at the mid-depth of the pavement slab or up to 1 inch below the mid-depth of the slab.
- Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is ¼ inch.
- Midpoint of the longitudinal axis of each dowel is at the center of the joint ( $\pm 1$  inch).
- Longitudinal axes of the two end dowels are 4 to 8 inches from the longitudinal joints.
- Longitudinal axes of the dowels are spaced 12 inches apart.

Mark the location of each contraction joint on the subbase before placing concrete such that the assembly is properly positioned. Also mark the longitudinal midpoints of the dowels such that the saw cut operator can accurately locate first-stage saw cuts. In a slipform paving operation, mark the joint support midpoint on the subbase immediately adjacent to the pavement. In a fixed form paving operation, mark the joint support midpoint on the form or such that the saw cut operator can easily locate the joint midpoint. Do not cut the shipping wires.

Make first-stage saw cuts as soon as the concrete has hardened sufficiently to permit sawing without causing raveling wider than 1/8 inch. Replace blades if raveling persists. Center first-stage saw cuts within 1 inch of the longitudinal midpoints of the dowels.

Complete first-stage saw cuts before any uncontrolled cracking occurs. Be prepared to make first-stage saw cuts 24 hours a day to prevent uncontrolled cracking. Provide lighting required to make first-stage saw cuts at night at no additional cost to the State.

Sweep or wash first-stage saw cut debris from the pavement before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.

**2. Transverse Expansion Joints.** Construct transverse expansion joints as part of the utility and drainage structure isolation systems depicted in the Standard Sheets or where indicated in the contract documents. Handle and position expansion joint supports in accordance with §502-3.06A1, Transverse Contraction Joints.

Construct expansion joints using 1/2 inch thick remolded resilient joint filler placed in 1 piece between longitudinal joints. Tightly place and support abutting sections of joint filler such that no concrete infiltrates the joint. Place expansion caps on the dowels as depicted in the Materials Details. Do not tap or hammer the caps onto the dowels.

No saw cuts are required in expansion joint construction. Remove the finishing cap, if supplied, after the concrete has developed sufficient strength to prevent damage.

**3. Transverse Construction Joints.** Construct transverse construction joints wherever there is an interruption of more than 30 minutes in concrete paving operations. Construct these joints as wide as the concrete placement, typically 1 or 2 lanes, but not necessarily the full pavement width. Align construction joints with transverse contraction or construction joints in adjacent lanes. Construction joints may be formed by bulk heads, saw cuts, concrete removal, or any combination thereof.

When required, drill and anchor dowels in accordance with §502-3.06D, Drill and Anchor Dowels or Ties, such that they meet the positioning requirements of §502-3.06A1, Transverse Contraction Joints.

*a. Bulkheads.* Ensure the bulkhead can support the weight of the plastic concrete. Bulkheads may be slotted or solid. Place a slotted bulkhead over the dowels of an exposed joint assembly such that half of the dowel lengths are embedded within newly placed concrete. Immediately remove plastic concrete in front of the bulkhead and from the exposed joint support.

The transverse joint assembly may be omitted and a solid bulkhead may be used. In this case, drill and anchor dowels, if required, into the transverse joint face.

*b. Saw Cut.* Saw cut full depth construction joints at locations that satisfy the minimum and maximum slab length requirements of §502-3.06A, Transverse Joints. Saw cut when the concrete has obtained sufficient strength to be saw cut without damage to concrete to remain in place. Do not cut within 12 inches of a longitudinal joint tie. Remove the hardened concrete ahead of the saw cut. Drill and anchor dowels, if required, into the saw cut face such that they meet the positioning requirements. Do not drill into longitudinal joint ties.

In lieu of drilling holes, the contractor may use transverse joint supports fabricated with closed-end, hollow plastic cylinders instead of dowels. Use hollow cylinders with outer diameters equal to the drilled hole diameters described in §502-3.06D, Drill and Anchor Dowels or Ties. Position cylinders as required in §502-3.06A1, Transverse Contraction Joints.

Saw cut the newly placed concrete full depth and full width through the midpoint of the longitudinal axis of each cylinder ( $\pm 1$  inch). Remove hardened concrete and the joint assembly ahead of the saw cut. Remove the hollow cylinder embedded in the concrete that remains and anchor the dowels in accordance with §502-3.06D, Drill and Anchor Dowels or Ties, to the required alignment in §502-3.06A1, Transverse Contraction Joints.

*c. Removal.* Remove all concrete to the midpoint of the preceding transverse joint without damaging the dowels, dowel coatings, or the pavement to remain in place.

**4. Transverse Hinge Joints.** Do not place hinge joints without the Engineer's approval. Construct transverse hinge joints when a slab length exceeds the geometric requirements of §502-3.06, Transverse Joints. (This situation typically occurs near structures that are skewed from perpendicular to the pavement centerline.)

Locate hinge joints such that they are equally spaced between other types of transverse joints. Construct hinge joints in accordance with §502-3.06A1, Transverse Contraction Joints, except the positioning requirements do not apply. Instead, position transverse hinge joint supports such that the:

- Entire longitudinal axis of each deformed bar is located at the mid-depth of the pavement slab or up to 1 inch below the mid-depth of the slab.
- Longitudinal axes of the bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 1 inch.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\pm 1$  inch).
- Longitudinal axes of the two end bars are 4 to 10 inches from the longitudinal joints.
- Longitudinal axes of adjacent bars are spaced 4 to 18 inches apart.

**B. Longitudinal Joints.** When a longitudinal joint item is specified, select tie type, size, spacing, and positioning in accordance with the 502 Standard Sheets and contract documents. Provide a minimum clearance of 3 inches between the end ties in a slab and any part of the transverse joint support. Keep ties free of materials that inhibit bonding to concrete or anchoring material. Maintain ties in their proper position during paving.

It is highly desirable to align longitudinal joints with the permanent pavement markings. Tied longitudinal joints located in the wheel paths of the completed pavement will require ties placed 24" on center.

**1. Longitudinal Joints Between Lanes Paved Simultaneously.** Use one-piece ties fabricated into assemblies capable of securely holding 2 or more ties. Secure the assemblies to subbase prior to paving in accordance with the Materials Details.

Make first-stage saw cuts parallel to the pavement centerline and perpendicular to the pavement surface before uncontrolled cracking occurs. Use equipment specified in §502-3.01D, Saw Cutting Equipment. Replace saw blades if raveling wider than 1/8 inch occurs. Center first-stage saw cuts within 1 inch of the longitudinal midpoint of the ties.

Sweep or wash first-stage saw cut debris from the pavement before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.

**2. Tied Longitudinal Joints Between Lanes Paved Separately.** In a slip form operation, construct a butt joint and drill and anchor one-piece ties into the hardened concrete in accordance with §502-3.06D, Drill and Anchor Dowels and Ties.

Use # 6 ties, 22 inches (minimum) long between travel lanes and 18 inches (minimum) long between a travel lane and a PCC shoulder. Anchor ties between travel lanes 10 inches into the previously placed concrete, leaving 12 inches (minimum) projecting from the joint face. Anchor ties between a travel lane and a PCC shoulder 8 inches (minimum) into the previously placed concrete, leaving 10 inches projecting from the joint face.

Place end ties in a slab 14 to 18 inches from the transverse joint. Typically, space ties between the end ties 36 inches apart, maximum. Pavements having 4 or more tied lanes, or 3 lane pavements 12 inches (or more) thick, may require a decreased spacing in accordance with the contract documents.

In a fixed form operation, construct either a butt or a keyed joint. Drill and anchor one-piece ties as discussed above, or use multiple-piece ties. Apply a corrosion inhibiting coating to the threads of all multiple-piece tie components before assembly. Bolt the female portion of the tie to

the form prior to paving as depicted in the Standard Sheets. Insert and tighten the male ends before paving the adjacent lane. Ensure all threaded connections are tight.

First-stage saw cuts are not required between lanes paved separately.

**3. Untied Longitudinal Joints.** Construct untied longitudinal joints at utilities and/or drainage structures, at intersections, between adjacent lanes having non-parallel center lines (such as ramps), or where indicated in the contract documents. Form as depicted in the Standard Sheets. Transverse joint type, location, and alignment may be changed when a transverse joint intersects an untied longitudinal joint.

Patch honeycombing along the untied longitudinal joint face to achieve a smooth surface prior to applying the bond breaker and placing the adjacent concrete.

First-stage saw cuts are not required.

**C. Utility and Drainage Structures and Telescoping Manholes.** Detail jointing around each utility and drainage structure in the proposed joint layout submitted to the Engineer for approval. Refer to the Standard Sheets for jointing and reinforcement around utilities and drainage structures. When possible, do not isolate, or “box out,” utilities and drainage structures from the pavement. Instead, set and center utilities and drainage structures between transverse joints and pave the slab with the structure at the same time as the surrounding pavement. Use a minimum slab length,  $L_{\min}$ , as defined in §502-3.06A, Transverse Joints. Reinforce the slab that contains the structure. Select reinforcement size and spacing such that:

$$A_s \geq 0.0018(s)(t)$$

where:

$A_s$  = Area of a steel bar (in<sup>2</sup>)

$s$  = Spacing of steel bars (in). Minimum 3” clearance between bars.

$t$  = Slab thickness (in)

Use mat reinforcement with steel in both directions. Use top and bottom double mat reinforcement for slabs thicker than 10”. Refer to the Standard Sheet for mat reinforcement placement locations.

When using telescoping manholes, remove temporary support bolts from the telescoping manhole casting as soon as the concrete hardens.

**D. Drill and Anchor Dowels or Ties.** Do not drill holes until the concrete has developed sufficient strength to withstand drilling without damage. Damage from drilling shall be addressed in accordance with §502-3.14, Damaged or Defective Concrete.

Drill such that the hole diameters are in accordance with the anchoring material manufacturer’s written recommendations. Replace worn bits when necessary to ensure the proper hole diameter is drilled.

Follow the anchoring material manufacturer’s written recommendations for cleaning the holes. As a minimum, clean the drilled holes with compressed air. Insert the nozzle to the back of the hole to force out all dust and debris.

When using new cartridges of anchoring material, ensure the initial material exiting the nozzle appears uniformly mixed. If it is not uniformly mixed, waste the material until uniformly mixed material extrudes.

Place the anchoring material in the back of the hole using a nozzle with sufficient reach. Push the dowel or tie into the hole while twisting such that the air pocket within the hole is heard to burst and

the anchoring material is evenly distributed around the bar. Use sufficient amounts of anchoring material such that it slightly extrudes out the hole as the bar is inserted.

**502-3.07 Paving Adjacent To Existing Concrete.** Wherever paving equipment operates on existing PCC pavement that is to remain, install bolt-on track covers or rubber tired, flangeless wheels. Remove all debris on the existing PCC pavement in the equipment track. Immediately remove any concrete that spills onto the existing concrete.

When paving from (or to) a transverse construction joint or intersecting pavement, use hand-held vibrators to thoroughly consolidate any concrete inaccessible to the paving equipment vibrators. Hand finish these areas with the minimum effort required to produce an acceptable surface. Do not dump the grout box head into the pavement concrete when approaching a construction joint.

**502-3.08 Plastic Thickness Determination.** Provide the Engineer with a round, rigid, nonaluminum probe, having a 1/8 inch diameter. The Engineer will determine the plastic concrete thickness by inserting the probe and measuring the insertion depth. The Engineer will check thickness at least every 150 feet of paving and at least 2 feet from the placement edge. Keep several probes at the project.

The minimum measured plastic thickness must be equal to (-1/4 inch) or greater than the thickness required in the contract documents. Areas not meeting minimum thickness will be treated in accordance with §502-3.14, Damaged or Defective Concrete. If 2 consecutive measurements do not meet minimum thickness, stop paving and reestablish the paving operation to achieve acceptable thickness.

**502-3.09 Finishing.** Provide an ACI certified concrete flatwork finisher to supervise finishing. Provide proof of ACI flatwork certification to the Engineer.

Mechanically finish the pavement after consolidation and strike off. Use machine mounted finishers such as full-width finishing pans, transverse oscillating screeds, longitudinal floats, pan floats or separate pieces of equipment such as tube floats. Correct bumps with a 16 foot straight edge or bump cutter specifically made for finishing concrete.

After mechanical finishing, hand finish the pavement to correct and seal minor imperfections. Hand finish with magnesium floats, lutes, and/or trowels. Use work bridges to hand finish concrete inaccessible from the pavement edge. Keep hand finishing to a minimum. Do not use excess mortar or discarded concrete to fill low areas. Do not add water to the concrete surface to close imperfections. Do not trowel bleed water into the surface. Stop paving or reformulate the concrete mix if surface imperfections that require additional water to close routinely occur.

Ensure the saw cut operator can locate joint sealant locations between separate, adjacent placements. This may be accomplished with a small radius (1/4 inch) edger along the edge of the second placement.

**502-3.10 Texturing.** Immediately after finishing and prior to applying the curing compound, texture the concrete surface using one of the following procedures in accordance with the contract documents. Apply longitudinal tining if no texturing method is designated in the contract documents. Additional requirements, such as Mean Texture Depth measured by a sand patch test or a profiler may be performed to check texturing adequacy. For a closed drainage system, provide an 8 - 12 inch blank in the texture along the pavement edges to enhance drainage to catch basins.

**A. Longitudinal Tining.** Texture the concrete parallel to the pavement centerline with a set of evenly spaced spring steel tines. Use rectangular tines 1/8 inch wide, 1/32 inch thick, and approximately 5 inches long at a center-to-center spacing of 3/4 inches.

Operate the tine head manually or mechanically. In either case, hold the tines as near an angle of 45° to the concrete surface as possible to minimize mortar dragging. Produce tine texture 1/16 - 1/8 inch deep with minimal dislodging of aggregate. Do not make multiple tine passes in the same area. Keep tines 2 - 4 inches from the placement edges. Keep the tines free of hardened concrete.

**B. Artificial Turf Drag.** Use a seamless strip of artificial turf drag appearing on the Department's Approved List entitled "Turf Drag" under "Equipment, Concrete Related." Produce a consistent texture, free of ridges or gouges, parallel to the pavement centerline either by hand or by attaching a weighted strip to the paver, texture/cure machine, or work bridge. Periodically replace or clean the drag to remove hardened concrete paste that compromises texture.

**502-3.11 Curing.** Apply curing compound no later than 5 minutes after texturing. The Engineer may stop paving if curing lags beyond the time limits noted. Cure Class C concrete placed between June 1 and September 15 for 4 days, minimum. Cure Class C concrete placed between September 16 and May 31 for 6 days, minimum. Cure HES or alternate mixes in accordance with Materials Bureau requirements based on the Contractor-submitted mix design and the trial batch evaluation.

**A. White Pigmented Membrane Curing Compound.** Cure concrete with white pigmented membrane curing compound. Mix the curing compound before each use and continuously agitate during use. Uniformly coat all exposed surfaces (including slipformed edges and formed edges immediately after form removal) at a minimum rate of 150 sf/gal such that the coated surfaces are completely white. Check the application rate after every paving day, including exposed vertical slab faces in the calculations. Apply the curing compound in 2 direction passes with no longer than 15 minutes between passes.

Immediately reapply curing compound to any damaged coating areas before the curing compound sets. During curing equipment breakdown, cure the pavement in accordance with §502-3.11B, Curing Covers. Do not apply curing compound in the rain. If rain damages the curing compound before it sets, reapply curing compound after the pavement surface dries.

**B. Curing Covers.** Use of curing covers is subject to the approval of the Engineer. Use quilted covers, plastic coated fiber blankets, or polyethylene curing covers. Do not use covers with tears or holes. Cover all exposed surfaces and extend the covers a minimum of 12 inches beyond the pavement edges or beyond the forms, when used. Overlap successive covers 12 inches, minimum. Secure the covers to keep them in contact with the entire surface and maintain the overlap. Wet the entire surface of quilted covers and maintain them in a wetted condition until pavement is eligible to be opened to construction traffic.

**C. Cold Weather Curing.** Supply form insulating materials for winter concreting when the air temperature is going to fall below 40°F at any time until pavement is eligible to be opened to construction traffic. Use material capable of maintaining a surface temperature of 55°F and being easily removed and replaced to accommodate first-stage saw cuts. Apply the insulating material to prevent newly placed concrete from being exposed to air temperatures below 35°F for the curing period. Secure the insulation tight to the concrete surface to prevent air intrusion beneath the insulation. Extend the insulation 12 inches beyond the newly placed concrete. Insulate the pavement vertical edge and/or forms as well.

Place recording surface thermometers between the pavement surface and insulating material 12 inches from one of the placement edges wherever insulation is used. Use 4 equally spaced thermometers for each day's paving. Do not subject the concrete to a temperature drop in excess of 50°F during the first 24 hours after removing the insulation.

**502-3.12 Sealing Joints.** Seal joints in accordance with the Standard Sheets.

First-stage saw cuts may be temporarily left unfilled if a placement is only subjected to occasional construction traffic, such as pickup trucks or cars. In this case, ensure debris does not enter the joints.

Temporarily fill unsealed first-stage cuts with jute or backer rod if a placement is:

- Subjected to consistent construction traffic.
- Used as a haul road for subsequent concrete placements.

- Temporarily opened to general traffic while final sealing has been delayed for convenience, such as to maximize sealing production.

Before cleaning, remove any temporary fillers and repair damaged joints in accordance with §502-3.14, Defective or Damaged Concrete, including chipped joints resulting from debris accumulation in an unfilled or unsealed joint.

**A. Highway Joint Sealant.** Widen joints to 1/4 - 3/8 inch for a depth of 1 inch to allow full-depth sealing. Immediately wash the widening cut slurry from the pavement such that it does not reenter the joint.

Clean the joints by abrasive blasting before sealing. Keep the nozzle within 2 inches of the joint surfaces. If the project does not allow abrasive blasting, The Engineer may allow pressure washing as an alternate preparation method. When pressure washing, use (1) a 900 psi minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Immediately after pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces. Ensure the joint is completely dry before sealing.

Do not allow any traffic on the pavement between cleaning and sealing. Reclean the joint if it rains between cleaning and sealing or if any traffic is on the placement between cleaning and sealing.

Provide the Engineer a copy of the sealant Manufacturer's written recommendations for heating and application at least 1 work day before sealing. Follow those recommendations. Unless stated otherwise, the recommended pouring temperature is 40°F below the manufacturer's designated safe heating temperature, with an allowable variation of 40°F.

Prior to sealing, discharge sealant from the applicator wand into a vessel and measure the sealant temperature. The temperature must be equal to or above the Manufacturer's recommended minimum pouring temperature and equal to or below the Manufacturer's recommended safe heating temperature.

Do not use sealant heated above the safe heating temperature. Sealant may be reheated or heated in excess of 6 hours if allowed by the Manufacturer's heating and application recommendations. In these cases, recharge the melter with fresh sealant amounting to at least 20% of the sealant volume remaining in the melter.

Seal joints immediately after cleaning. Seal the joint from the bottom of the cut to within 1/2 inch of the pavement surface. Seal when the:

- Air and surface temperatures are 40°F or warmer.
- Air temperature is above the dew point.
- Pavement surface and all joint surfaces are dry.

Open to traffic after the sealant has cured to prevent tracking. Do not blot with fine aggregate.

**B. Sealing Joints - Preformed Joint Sealers.** Make second-stage saw cuts and/or bevels in accordance with the Standard Sheets and (1) no sooner than 72 hours after concrete placement and (2) after the curing period has ended if curing covers are used. Extend the second-stage saw cut vertically down the free concrete edges. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels.

Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled while open to any traffic. Temporarily fill second-stage saw cuts with jute or backer rod if (1) they are exposed to any traffic before cleaning and sealing or (2) weather conditions are not favorable for timely (within 2 calendar days) cleaning and sealing, whether or not they are exposed to any traffic.



Clean the joints by pressure washing before sealing. Use (1) a 900 psi minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Within 24 hours of pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces. Reclean the joint if it rains between cleaning and sealing. Do not allow any traffic on the pavement between cleaning and sealing.

Install the sealant in accordance with the Manufacturer's written instructions. Lubricate the concrete, the sealer, or both before installation such that the lubricant fully covers the sealer/concrete interface, but not the top of the sealer.

Install one piece of transverse joint sealer in a compressed condition across the full pavement width, including concrete shoulders, and down the vertical saw cut at the free edge. Cut the longitudinal sealer where it crosses a transverse joint. Do not splice the longitudinal sealer between transverse joints. Seal the intersection between longitudinal and transverse sealers with lubricant.

Install the sealer such that it is not stretched more than 5%, nor compressed more than 2%, of the minimum theoretical length. Check the installation for stretch and compression by installing sealers in 5 transverse joints and removing the sealer immediately after installation and checking the length. An alternate method for checking stretch and compression, where applicable, may be performed by premarking or precutting the sealer to length prior to installation. If the measurement of any of these 5 sealers exhibits stretching in excess of 5% or compression in excess of 2%, modify the installation method to meet the requirements or discontinue installation.

Once sealing operations begin, remove 1 joint per 100 in the presence of the Engineer to check stretch and compression. If the sealer is found to be stretched in excess of 5% or compressed in excess of 2%, remove the sealer material from successive joints in both directions until sealers are found that meet the stretch and compression requirements. Replace all joints sealers found with excess stretch or compression. Replace joint sealers removed and found to meet the stretch and compression requirements.

**502-3.13 Pavement Protection.** Protect the pavement and appurtenances from traffic and construction operations. Protect the work and provide for traffic as indicated in the contract documents.

**502-3.14 Damaged or Defective Concrete.** The Engineer will identify all areas of damaged and defective concrete. Submit a repair plan for the damaged or defective concrete to the Engineer for approval. Repair or replace all damaged or defective concrete in accordance with the approved repair plan. Damage and defects include, but are not limited to, cracking, spalling, poor consolidation, out of specification materials, or imperfections caused by inadequate pavement protection, traffic, and/or construction practices. Slipformed concrete with inadequate plastic thickness as described in §502-3.08, Plastic Thickness Determination, will be rejected in 150 foot segment lengths.

**502-3.15 Hardened Surface Tolerance.** After the concrete has hardened sufficiently, test each travel lane, including ramps, with straight edges laid both longitudinally and transversely. Do not measure transverse deviations across longitudinal joints. The Engineer will mark longitudinal deviations in the pavement surface exceeding 1/4 inch in 15 feet and transverse deviations exceeding 1/4 inch in 10 feet. Diamond grind these deviations in accordance with §505-3.02, Bump Grinding, such that they do not exceed these parameters when retested.

Shoulders and other areas not routinely exposed to traffic must meet 1/4 inch in 10 feet both longitudinally and transversely.

### **502-3.16 Opening to Traffic**

**A. Construction Traffic.** Open Class C concrete pavement to construction traffic and paving equipment at least 7 days after placement. With the Engineer's approval, the time may be shortened to

3 days if cylinders meet the requirements of Table 502-3 Pavement Opening Requirements. Any pavement damaged from opening to construction traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

**B. General Traffic.** Open Class C concrete pavement to general traffic placed between June 1 and September 15 at least 10 days after placement. Open Class C concrete pavement to general traffic placed outside of the above dates at least 15 days after placement.

With the Engineer’s approval, these times may be shortened to 4 days if cylinders meet the requirements of Table 502-3 Pavement Opening Requirements, and the joints are addressed in accordance with §502-3.12, Sealing Joints.

Any pavement damaged from opening to general traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

<b>TABLE 502-3 PAVEMENT OPENING REQUIREMENTS</b>		
<b>All the Following Must Apply:</b>	<b>Construction Equipment</b>	<b>General Traffic</b>
Minimum Average compressive strength of all cylinder pairs	2500 psi	3000 psi
Minimum Average compressive strength of each cylinder pair	2000 psi	2500 psi

Note: Automobile only areas may be opened at 1500 psi.

**C. Project Strength Determination.** Provide an ACI Certified Concrete Field Testing Technician, Grade I, or higher, to cast all cylinders. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer’s representative. Provide acceptable proof of ACI Certification and AASHTO Accreditation to the Engineer before placing any concrete.

The Engineer, or the Engineer’s representative, will complete the Concrete Cylinder Report as cylinders are cast and tested.

Cast a minimum of 3 cylinder pairs (6 total) from each 1000 feet of paving length, or fraction thereof, in accordance with *Materials Method 9.2, Field Inspection of Portland Cement Concrete*. Cast each pair from different delivery trucks. Develop an Engineer-approved marking system that allows a cylinder to be readily associated with the corresponding placement location and placement time. Mark the cylinders and place them adjacent to the pavement under similar curing conditions. Determine the concrete compressive strength at the desired time in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. The pavement may be opened to construction (or general) traffic if all the cylinders meet the requirements of Table 502-3 Pavement Opening Requirements.

If these conditions are not met, test 3 additional cylinder pairs at a later time, provided the appropriate numbers of additional cylinders were cast. If the above conditions are not met after additional testing, or, if the required number of additional cylinders were not cast, open the pavement in accordance with the nonreduced time frames of §502-3.16A, Construction Traffic, and §502-3.16B, General Traffic.

**D. HES Concrete.** Open HES concrete pavements to construction traffic or general traffic based on the requirements of Table 502-3 Pavement Opening Requirements, and if the joints have been addressed in accordance with §502-3.12, Sealing or Filling Joints.

**E. Maturity.** ASTM C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method, may be used to open the pavement to traffic. Inform the Engineer of the intent to use this method at least 28 days before producing any pavement concrete. Submit a maturity curve development plan to the Engineer that includes an equipment list, the date and time of batching, the

testing facility name and address, which must meet §502-3.16C, Project Strength Determination, requirements, and any variations to ASTM C1074. Perform all batching and testing related to developing the maturity curve with the Engineer and Regional Materials Engineer present. Open to traffic at the strengths identified in Table 502-3 Pavement Opening Requirements.

**502-4 METHOD OF MEASUREMENT.** The Engineer will measure the following quantities for items incorporated into the finished pavement:

**502-4.01 PCC Pavement, Unreinforced.** The work will be measured for payment as the number of cubic yards of unreinforced PCC pavement placed based on the payment lines shown in the contract documents, to the nearest cubic yard. Deductions will be made for catch basins, manholes, or other similar pavement obstructions requiring either mesh reinforced or heavily reinforced placements.

**502-4.02 PCC Pavement, Mesh or Heavily Reinforced.** The work will be measured for payment as the number of cubic yards of reinforced concrete placed. No deductions will be made for drainage and utility structures or other similar pavement obstructions within the placement.

**502-4.03 Transverse Joints.** The work will be measured for payment as the number of feet of transverse joints constructed that contain load transfer devices.

**502-4.04 Longitudinal Joints.** The work will be measured for payment as the number of feet of longitudinal joints satisfactorily constructed that contain longitudinal joint ties.

**502-4.05 Sealing Transverse Joints.** The work will be measured for payment as the number of feet of transverse joints sealed, excluding preformed sealers turned down at the pavement edges.

**502-4.06 Sealing Longitudinal Joints.** The work will be measured for payment as the number of feet of longitudinal joints satisfactorily sealed.

## **502-5 BASIS OF PAYMENT**

**502-5.01 This subsection is intentionally blank.**

**502-5.02 PCC Pavement, Unreinforced.** Include the cost of all labor, material, and equipment necessary to perform the work, including first-stage saw cuts, in the unit price bid for PCC Pavement, Unreinforced. No payment will be made for areas that do not meet minimum plastic thickness requirements.

**502-5.03 PCC Pavement, Mesh or Heavily Reinforced.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work, including first-stage saw cuts, in the unit price bid for PCC Pavement, Mesh or Heavily Reinforced. No payment will be made for areas that do not meet minimum plastic thickness requirements.

**502-5.04 Transverse Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Transverse Joints.

**502-5.05 Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor's option, will not generate a Significant Change in the Character of Work. No additional payment will be provided for the additional number of longitudinal joint ties associated with:

- Constructing butt joints between lanes placed separately in a slipform paving operation.

- Constructing longitudinal joints in wheelpaths.

**502-5.06 Sealing Transverse Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Sealing Transverse Joints.

**502-5.07 Sealing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Sealing Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor’s option, will not generate a Significant Change in the Character of Work.

*Payment will be made under:*

Item No.	Item	Pay Unit	
502.RCFL	PCC Pavement	Cubic Yard	
<i>R – Pavement Reinf.</i>	<i>C – Concrete Class</i>	<i>F – Friction Type</i>	<i>L–Load Transfer</i>
<i>0 – Unreinforced</i>	<i>1 – Class C</i>	<i>1 – Type 1</i>	<i>0 – Epoxy coated</i>
<i>1 – Mesh Reinforced</i>	<i>2 – Performance</i>	<i>2 – Type 2</i>	
<i>2 – Heavily Reinforced</i>	<i>3 – HES</i>	<i>3 – Type 3</i>	
		<i>9 – Type 9</i>	
502.91	Transverse Joints	Foot	
502.9110	Longitudinal Joints	Foot	
502.9201	Sealing Transverse Joints – Preformed Elastic Joint Sealer	Foot	
502.9210	Sealing Transverse Joints – Highway Joint Sealant	Foot	
502.9301	Sealing Longitudinal Joints – Preformed Elastic Joint Sealer	Foot	
502.9310	Sealing Longitudinal Joints – Highway Joint Sealant	Foot	

**SECTION 503 - PORTLAND CEMENT CONCRETE FOUNDATION FOR PAVEMENT**  
(Last Revised May, 2019)

**503-1 DESCRIPTION.** Construct a portland cement concrete (PCC) foundation for pavements and shoulders, if required, as detailed in the contract documents.

**503-2 MATERIALS.**

Apply the requirements of §502-2 Materials.

**503-3 CONSTRUCTION REQUIREMENTS.** Apply the requirements of §502-3 Construction Details except as modified herein.

**503-3.01 Placement of Reinforcement.** Place bar reinforcement around utilities, drainage structures, and other projections into the pavement as depicted in the Standard Sheets for PCC Pavements. Use telescoping manholes when required by the contract documents in accordance with §502-3.06C, Utility and Drainage Structure Isolation Joint Systems and Telescoping Manholes.

**503-3.02 Joints.** Transverse joint supports are not required for contraction joints. Saw cut skewed contraction joints at a “6 on 1” skew across the pavement (approximately 10° from perpendicular to the centerline) before uncontrolled cracking occurs. Saw cut in accordance with the first-stage saw cut details in the Standard Sheets.

Use a maximum joint spacing of 20 feet and a minimum spacing that satisfies the geometric requirements of §502-3.06A, Transverse Joints. Center utilities and drainage structures between saw cuts. Skewed joints may be cut at the same angle across the pavement or chevron-shaped with the vertex at a longitudinal joint between separate placements. Maintain the same technique once selected. Construct transverse construction joints perpendicular to the centerline in accordance with §502-3.06A3, Transverse Construction Joints.

Construct longitudinal joints in accordance with §502-3.06B, Longitudinal Joints.

**503-3.03 Finishing.** Hand finish the pavement to correct surface irregularities.

**503-3.04 Testing the Surface.** Immediately after placement, test the entire longitudinal center of each travel lane with a 10 feet, minimum, long straight edge laid longitudinally. Immediately correct any surface irregularity exceeding 3/8 inches in 10 feet.

**503-3.05 Texturing.** Immediately after testing the surface, apply an aggressive transverse broom finish.

**503-3.06 Curing.** Cure in accordance with §502-3.11 Curing, except the impervious membrane method, i.e., curing compound, is not permitted.

**503-3.07 Sealing Joints.** Typically, no joint sealing is required in the PCC foundation course. Seal skewed contraction joints in accordance with §502-3.12A, Sealing Transverse Contraction Joints – Highway Joint Sealant, if a construction delay occurs that prevents the placement of the final pavement course until the subsequent construction season.

**503-4 METHOD OF MEASUREMENT.**

**503-4.01 Portland Cement Concrete Foundation for Pavement.** The work will be measured for payment as the number of cubic yards of Portland Cement Concrete Foundation for Pavement based on the payment lines shown in the contract documents. No deductions will be made for catch basins, manholes, or other similar pavement obstructions.

**503-4.02 Constructing Longitudinal Joints.** The work will be measured for payment as the number of feet of longitudinal joints constructed.

**503-5 BASIS OF PAYMENT.**

**503-5.01 Portland Cement Concrete Foundation for Pavement.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Portland Cement Concrete Foundation for Pavement. No payment will be made for areas that do not meet minimum plastic thickness requirements as described in §502-3.08, Plastic Thickness Determination. No additional payment will be made for Contractor-requested HES concrete mixes.

**503-5.02 Constructing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Constructing Longitudinal Joints.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
503.1010	PCC Foundation for Pavement, Class C	Cubic Yard
503.1011	PCC Foundation for Pavement, Class F	Cubic Yard
503.1012	PCC Foundation for Pavement, HES Concrete	Cubic Yard
503.9110	Constructing Longitudinal Joints in Foundation Pavement	Foot

## SECTION 504 VACANT

### SECTION 505 – DIAMOND GRINDING

(New Section May, 2019)

**505-1 DESCRIPTION.** Diamond grind portland cement concrete (PCC) or hot mix asphalt (HMA) surfaces in accordance with the contract documents.

**505-2 MATERIALS.** Provide the Engineer with a list of equipment and their specifications at least 7 days before the planned start of diamond grinding. Maintain the equipment in proper working order. Immediately replace any out-of-round wheels. Do not use equipment that causes raveling, aggregate fractures, or joint deterioration.

**505-2.01 Production Diamond Grinding Equipment.** For projects having grinding quantities over 3,000 yd<sup>2</sup>, use a self-propelled machine specifically designed for grinding that meets the following:

- Equipped with 50 – 60 gang-mounted diamond saw blades per foot on a multi-blade arbor capable of producing a 3 foot wide, minimum, strip of ground surface.
- Having blade spacers with a minimum thickness of 0.105 inches.
- Equipped with a vacuum system capable of removing the grinding slurry from the surface, leaving the surface in a clean, near-dry condition.
- Weighing a minimum of 35,000 pounds with the grinding head.
- Having a minimum effective wheel base (distance between the transverse pivot points of the front wheel assembly and the profile/depth-control/ground drive wheels) of 12 feet.

**505-2.02 Bump Grinding Equipment.** Use equipment meeting §505-2.01 Production Diamond Grinding Equipment, except the equipment must weigh at least 17,000 pounds. This equipment may only be used for grinding quantities of 3,000 square yards, or less.

### 505-3 CONSTRUCTION DETAILS.

**505-3.01 General.** Provide at least one 10-foot straightedge and one 15-foot straightedge to the Engineer before paving begins. Diamond grind longitudinally, beginning and ending at lines normal to the centerline, and in full travel lane width increments. Provide surface drainage by maintaining the proper cross slope and by blending adjacent passes. Grind such that there is no unground area between passes and the passes do not overlap by more than 1 inch. Remove unbroken fins 3/16" high by 4" long or larger at no additional cost to the Department.

Continuously vacuum the slurry leaving a clean, near-dry condition. If roadside slurry discharge is not allowed, transfer the slurry into equipment capable of transporting it away without spills. Dispose of slurry in accordance with §107-10 *Managing Surplus Material and Waste*. Do not allow slurry to enter occupied travel lanes, drainage structures, wetlands, streams, estuaries, or sensitive environmental resources, or areas where it will become a public nuisance.

**505-3.02 Bump Grinding.** Use production grinding equipment or bump grinding equipment. Test the ground surface using a 15 foot straightedge laid longitudinally and a 10 foot straightedge laid transversely. Re-grind areas that exceed 1/4 inch high in 15 feet longitudinally and/or 1/4 inch high in 10 feet transversely. Grind such that there is no more than a 1/16 inch vertical differential between the adjacent sides of transverse joints and cracks.

**505-3.03 Production Grinding – New PCC Pavement.** Grind such that a minimum of 95% of the surface of new PCC pavement is ground. Grind the transitions between the travel lanes and shoulders, auxiliary lanes, ramps, and/or other unground areas, such that proper surface drainage is achieved and there are no longitudinal ridges exceeding 3/16 inch.

After grinding, collect, analyze, and report pavement ride quality data in accordance with Section 653 Pavement Ride Quality. Grind such that each Pavement Ride Quality (PRQ) lot meets Table 505-1, New PCC Pavement Smoothness Requirements.

TABLE 505-1 NEW PCC PAVEMENT SMOOTHNESS REQUIREMENTS	
International Roughness Index (IRI)	≤ 70 inches per mile
Localized Roughness (LR) <sup>1</sup>	≤ 135 inches per mile

Note 1: When determined using the ProVAL assurance module with a 25 foot baseline.

**505-3.04 Production Grinding for Pavement Preservation.** For pavements with posted speeds of 45 mph or greater, obtain a control profile in accordance with Section 653 *Ride Quality* before performing corrective work. Use the control profile to identify the maximum post-grind IRI for each PRQ lot as indicated in Table 505-2 *Pavement Preservation Smoothness Requirements*. Re-grind as necessary to achieve the smoothness.

Grind such that at least 95% of the surface is diamond ground and there is no more than a 1/16 inch vertical differential between the adjacent sides of transverse joints and cracks. Grind the transitions between the travel lanes and shoulders, auxiliary lanes, ramps, and/or other unground areas, such that proper surface drainage is achieved and there are no longitudinal ridges exceeding 3/16 inch.

For pavements with posted speeds less than 45 mph, the Engineer will test the ground surface using a 15 foot straightedge laid longitudinally and a 10 foot straightedge laid transversely. Re-grind areas exceeding 1/4 inch high in 15 feet longitudinally and/or 1/4 inch high in 10 feet transversely. Do not test across longitudinal joints or outside the ground area.

After grinding, re-profile the surface using the same equipment, methods, and PRQ lots used to develop the control profile, ensuring that the profile PRQ lot locations match the control PRQ lot locations.

TABLE 505-2, PAVEMENT PRESERVATION SMOOTHNESS REQUIREMENTS		
Control Profile PRQ Lot IRI	≤ 180	> 180
Required Post-Grind IRI	≤ 90	≤ 0.50 x (Control IRI)

In addition to meeting the smoothness requirements of Table 505-2, grind such that:

- For pavements with posted speeds of 45 mph or more, the Localized Roughness (LR) will be less than or equal to 135 inches per mile when determined using the ProVAL Assurance Module with a 25 foot baseline.
- The post-grind cross slope mirrors the pre-grind cross slope with no depressions or misalignment exceeding 1/4 inch in 10 feet when measured with a 10 foot straightedge placed perpendicular to the centerline.
- Wheelpath rutting is removed such that the texture is consistent across the lane.

Determine a smoothness quality adjustment for each PRQ lot if that item is included in the contract documents.

#### 505-4 METHOD OF MEASUREMENT.

**505-4.01 Bump Grinding.** The quantity to be measured for payment will be in square yards of surface bump ground. Only bump grinding associated with pavement restoration repairs will be measured for payment.

**505-4.02 Production Grinding of New Pavement.** The quantity to be measured for payment will be in square yards of surface diamond ground.

**505-4.03 Production Grinding for Pavement Preservation.** The quantity to be measured for payment will be the number of square yards of surface ground. No deductions will be made for isolated, unrepaired settlements.

**505-4.04 Smoothness Quality Adjustment.** The quantity to be measured will be the number of Quality Units of Smoothness Quality Adjustment, if any, payable for each ground PRQ lot determined by the following:

$$\text{Quality Units (per PRQ lot)} = (\text{SAF} - 1.00) \times \text{PRQ lot area}$$

The Smoothness Adjustment Factor (SAF) from Table 505-3 *Smoothness Adjustment Factors*, is based on the percent improvement in IRI between the control profile and the post-grind profile.

TABLE 505-3, SMOOTHNESS ADJUSTMENT FACTORS	
IRI Improvement (%)	Smoothness Adjustment Factor (SAF)
≥ 65	1.10
60 – 64	1.07
55 – 59	1.05
50 – 54	1.00

**505-5 BASIS OF PAYMENT.**

**505-5.01 Bump Grinding.** The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.

**505-5.02 Production Grinding of New Pavement.** The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.

**505-5.03 Production Grinding for Pavement Preservation.** The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.

**505-5.04 Smoothness Quality Adjustment.** Quality Units for Smoothness Quality Adjustment are a fixed price in the bid documents.

Payment of Quality Adjustments will be made based on the Smoothness Adjustment Factor (SAF) multiplied by the fixed index price for Quality Adjustment Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

*Payment will be made under:*



Item No.	Item	Pay Unit
505.0101	Bump Grinding - PCC	Square Yard
505.0102	Bump Grinding - PCC with Slurry Removal	Square Yard
505.0201	Production Grinding – New PCC Pavement	Square Yard
505.0202	Production Grinding – New PCC Pavement with Slurry Removal	Square Yard
505.0401	Production Grinding – Pavement Preservation	Square Yard
505.0402	Production Grinding – Pavement Preservation with Slurry Removal	Square Yard
505.0403	Smoothness Quality Adjustment	Quality Unit

## SECTIONS 506 THRU 549 (VACANT)

# Section 550

## STRUCTURES

### SECTION 551 - DEEP FOUNDATION INSTALLATION AND TESTING (Last Revised May, 2022)

#### 551-1 DESCRIPTION

**551-1.01 General.** This work shall consist of furnishing and installing deep foundations of the type and size, designed to transfer load through shallow deposits to suitable bearing strata, at the locations indicated in the contract documents. The Contractor shall also perform load testing and/or integrity testing as indicated in the contract documents to verify the design assumptions and load-carrying capacity of the deep foundation elements.

Timber piles are not covered under this specification.

#### 551-1.02 Definitions.

- A. Piles.** Piles are vertical structural elements of a deep foundation installed to transfer structural loads into the underlying ground.
- 1. Steel H-Piles.** A steel H-Pile is a hot rolled structural shape, where the shapes of the webs and the flanges are the same thickness, making a member that can be driven without twisting. Steel H-Piles are primarily used as an end bearing pile where the majority of the pile load is delivered to the material on which the tip rests.
  - 2. Cast-In-Place Concrete Piles.** A Cast-In-Place pile (CIP) is a pipe, or shell, driven into the ground primarily as a form to hold concrete. However, that casing serves as a means to transfer the loads from the casing surface to the surrounding soil by means of friction throughout the length of the pile (i.e. CIPs are friction piles). The distinction between a pipe and a shell is that the pipe can be driven on its own, while a shell is driven with a mandrel.
  - 3. Furnishing Equipment for Driving Piles.** Necessary equipment, including hammers, cushions, helmets, leads, followers, and methods for addressing obstructions (e.g. spuds or augers), for driving piles as shown in the contract documents.

4. **Dynamic Pile Load Testing.** Dynamic Pile Load Test (DPLT) uses measurements of strain and acceleration taken near the pile head as a pile is driven or restruck with a pile driving hammer. These dynamic measurements are used to determine the performance of the pile driving system, calculate pile installation stresses, assess pile integrity, and evaluate the nominal geotechnical resistance.
  5. **Splices.** A pile splice joins two segments of a driven pile using either a weld or mechanical means. The piece of the pile in the ground is referred to as the bottom whereas the piece added onto the pile in the ground is referred to as the top. Splices are contingent items and shall apply only when the Engineer directs the Contractor to drive a pile more than 10 feet beyond the estimated length provided in the contract documents.
- B. Micropiles.** A small-diameter (typically less than 12 inches) friction pile formed by removing material using non-vibratory and non-displacement methods to create a cased cylindrical open hole in the ground, which is subsequently filled with grout and steel reinforcement.
1. **API Mill Secondary or Mill Seconds.** Mill reject American Petroleum Institute (API) casing, a.k.a. “Mill Rejects,” “Structural Grade,” “Limited Service,” or “Minimum Test Pipe.” Mill seconds cannot be used for reinforcement.
  2. **API Prime Pipe.** Pipe meeting all the specified inspection and testing requirements set forth by API and having accompanying certifications. API standardized several grades of steel that have different chemical content, manufacture processes, and heat treatments and, therefore, different mechanical properties. The API grade letter designation is arbitrary and the numbers in the grade designation indicate the minimum yield strength of the steel in thousand psi. N80 is a relatively old grade with essentially open chemical requirements and is normally less expensive than L80 grade.
  3. **Bond Breaker.** A device or special treatment incorporated into a length of a micropile that will allow no load to be transferred to the soil over that length. A bond breaker also provides full lateral support of the pile over the length of the bond breaker.

Grout placed in contact with the soil using gravity pressure only will not be considered to constitute a bond breaker.
  4. **Bond Zone.** The gravity grouted, pressure grouted, and/or post grouted length of a micropile that provides the pile's resistance.
  5. **Drill Casing.** Steel pipe of flush joint type used in the drilling process to stabilize the drill hole.
  6. **Duplex Drilling.** A method of progressing and cleaning out a hole for installing a micropile in which the outer drill casing is progressed simultaneously with an inner drill rod string. The drill casing is cleaned using reverse circulation. Intimate contact between the soil and an outer drill casing is maintained during drilling.
  7. **Extended Length.** An additional pile length resulting from a requirement that the pile resistance be achieved below a given elevation. Typically, extended lengths are prompted by a conflict with subsurface elements (e.g., underground structure, utilities, etc.) or unreliable soil strata. Bond breakers may be required.

- 8. Furnishing Equipment for Installing Micropiles.** Necessary equipment at the work site for installing micropiles or permanent casings for micropiles as indicated in the contract documents.
- The equipment shall be capable of advancing drill casing and permanent casing, and drilling holes for micropiles by rotating the casing(s) and applying a static vertical load. The equipment shall be capable of cleaning out the inside of the casing(s) without disturbing the surrounding soil or excavating more than 1 foot ahead of the casing. The equipment shall be equipped with gauges conveniently located at the pile installation site to measure the volume of grout being pumped into the pile and the grouting pressure. The equipment shall be able to perform the work without removing or relocating existing utilities, structures, or structural members.
- 9. Non-Production Pile.** Non-production piles are piles that are not incorporated into the substructure. For example, test piles which are abandoned after testing has been completed.
- 10. Permanent Casing.** A steel casing installed in the upper portion of a micropile to increase the pile's moment resistance and lateral resistance against horizontal loads.
- 11. Positive Circulation or Flush.** A method of progressing and cleaning out a hole for a micropile wherein drilling fluid is injected into the hole and returns upward along the outside of the drill casing.
- 12. Post Grouting.** A method used to increase pile resistance after the grout column has reached initial set by pumping grout at very high pressure (up to 1000 psi) through a sleeved port pipe (post grout tube).
- 13. Pressure Grouting.** A method used to develop pile resistance wherein pressure is applied continuously to the top of the fluid grout column through the drill head as the casing is removed from the bond zone.
- 14. Production Pile.** A pile which will be incorporated into the structure's foundation.
- 15. Recirculation.** A method of handling drilling fluid where the fluid coming back out of the hole is captured in a pan and reused.
- 16. Reverse Circulation.** A method of cleaning the inside of the drill casing. Drilling fluid is circulated down through the drill rods and returns upwards through the inside of the drill casing to flush the drill casing clean.
- 17. Static Pile Compressive Load Test.** A test to verify design assumptions and the adequacy of the Contractor's installation methods.
- 18. Telltale.** A simple mechanical device, a.k.a. "strain rod," that is used to measure deflection in concrete or steel. The device consists of a small-diameter steel rod that is fixed at a selected point along or within the pile. This rod is encased, and free to move, in a slightly larger pipe or tube which extends up to the pile top. Dial gages are used to measure the deflections at the top of the rod.
- 19. Tremie Grouting.** A method used to place grout in a wet hole. A grout tube is placed to the bottom of the drill hole. While keeping the tube opening submerged in the grout, grout is pumped into the hole, causing the drilling fluid to be displaced.

- C. Drilled Shafts.** A cylindrical structural column transmitting loads to soil and/or rock. The drilled shaft is constructed in a hole with a circular cross section. The hole is filled with concrete and may be reinforced with steel.
1. **Casing (Shell).** A steel shell used to construct the drilled shaft. The casing can help advance the hole and supports the sides of the hole. Casing can be permanent, interim, or temporary.
  2. **Casing Method.** A method of shaft construction, consisting of advancing and cleaning a cased hole, placing the reinforcing cage, and concreting the shaft while extracting temporary casing (if used).
  3. **Crosshole Sonic Logging (CSL) of Drilled Shafts.** The CSL test is used to evaluate the integrity of the shaft concrete by measuring the response of an ultrasonic pulse traveling from a signal source in one access pipe to a receiver in another access pipe.
  4. **Drilling Mud.** A slurry made using bentonite or polymers (see Slurry).
  5. **Dry Construction Method.** A method of shaft construction consisting of drilling the shaft, removing water and material from the excavation, placing the reinforcing cage, and concreting the shaft in a relatively dry condition.
  6. **Furnishing Equipment for Installing Drilled Shafts.** Necessary equipment, including barges, platforms, and support vessels, for installing drilled shafts as shown in the contract documents.
  7. **Interim Casing.** A casing that acts as a form but remains in place permanently. It is not designed to carry structural loads.
  8. **Permanent Casing.** A casing that is designed to carry structural loads. It acts as a form and remains in place permanently.
  9. **Quality Assurance.** A test or procedure that acts to verify the quality of the work or product. Quality Assurance procedures would include static load testing, Osterberg cell testing, coring, cross hole sonic logging, and other non-destructive testing.
  10. **Rock.** Rock is identified in the boring logs. Rock may also be defined at the shaft installation site by a Departmental Engineering Geologist.
  11. **Seat.** The act of placing the tip of a casing in intimate contact on rock for its entire circumference.
  12. **Slurry.** A mixture of water and bentonite, or water and polymers, which provides hydrostatic pressure that supports the sides and bottom of the hole, lubricates and cools the drill tools, and aids clean-out. Slurry cannot be made from native materials, or material from the excavation.
  13. **Surface Casing.** Temporary casing installed to prevent sloughing of the surrounding soil near the surface of the shaft excavation.

- 14. Temporary Casing.** A casing that serves its function during construction of the drilled shafts. It serves no permanent structural function and is extracted during concreting.
- 15. Top of Socket.** The highest location of the rock socket that is capable of resisting axial and lateral design loads. At any given location, the top of socket elevation is usually below the top of rock elevation. This distance depends on the type and quality of the rock, and the Contractors drilling methods and equipment.
- 16. Tremie.** A method to place concrete under water. Refer to Section 555 *Structural Concrete*.
- 17. Trial Shaft.** A hole for a drilled shaft constructed on the project site, but outside the proposed footing limits. It is not to be incorporated into a structure or foundation. A trial shaft is constructed prior to installing production drilled shafts, according to the methods detailed in the Contractor's submittals. Its function is to verify the proposed excavation methods and permit the Inspectors to become familiar with the excavation procedure. Upon inspection and acceptance, the trial shaft is backfilled with unreinforced concrete.
- 18. Wet Construction Method.** A method of shaft construction in which slurry is used to maintain stability of the hole while advancing the excavation to the final depth, placing the reinforcing cage, and concreting the shaft.

## 551-2 MATERIALS

### 551-2.01 Piles

- A. General.** Materials for piling shall conform to the requirements of the following subsections of Section 700 *Materials and Manufacturing*:

Bar Reinforcement, Grade 60	§709-01
Casings for Cast-in-Place Concrete Piles	§720-03
Steel H-Piles	§720-04
Pile Shoes	§720-05
Mechanical Pile Splices	§720-06

- B. Steel H-Piles.** Steel H-Piles shall meet the requirements of §720-04 *Steel H-Piles*.

**C. Cast-In-Place Concrete Piles**

- 1. Casings for Cast-In-Place Concrete Piles.** Casings for Cast-In-Place Concrete Piles shall meet the requirements of §720-03 *Casings for Cast-In-Place Concrete Piles*.
- 2. Concrete for Cast-In-Place Piles.** Concrete placed in the Cast-In-Place Piles shall comply with requirements specified for Class A Concrete in Section 501 *Portland Cement Concrete - General*.
- 3. Cast-In-Place Concrete Pile Dimensions.** Pile dimensions, including the rate of taper for tapered piles, shall be as shown in the contract documents, or as approved by the DCES. In no case, however, shall the outside diameter at the toe be less than 8 inches nor shall the outside diameter at the section to be cut off be less than 12 inches.

The Contractor shall furnish the type of pile casing shown in the contract documents. No used pipe or shell will be permitted.

- D. Furnishing Equipment for Driving Piles.** None Specified
- E. Dynamic Pile Load Testing.** None Specified.
- F. Static Pile Compressive Load Testing (if Required).** Provide materials as required in Geotechnical Control Procedure (GCP-18) *Static Pile Compressive Load Test Manual*.
- G. Splices.** Mechanical Pile Splices shall meet the requirements of §720-06 *Mechanical Pile Splices*.

### 551-2.02 Micropiles

For all steel remaining as a permanent part of the work, all Buy America provisions shall apply. Mill certifications are required to meet Buy America provisions.

- A. Drill Casing.** Provide drill casing consisting of flush joint type steel pipe of appropriate thickness to withstand the stresses associated with advancing it into the ground, in addition to the stresses due to hydrostatic and earth pressures.
- B. Drill Casing/Pipe Used As Reinforcement.** Provide steel drill casing/pipe used as reinforcement meeting, at a minimum, the strength requirements of ASTM A252. Mill seconds cannot be used for reinforcement.

Approval of the steel drill casing/pipe used as reinforcement shall be done in accordance with the following procedure:

  - 1. Requirements for Micropile Structural Casing.** Structural casing that is installed in coupled (spliced) sections shall meet the following requirements:
    - a. The casing shall be flush-joint, and the pipe joint shall be completely shouldered and with no stripped threads.
    - b. All welded connections shall be performed by a NYSDOT Certified Welder in conformance with NYSDOT Steel Construction Manual (SCM), the approved Welding Procedure Specification (WPS) and the Approved Welding Procedure Qualification Record (WPQR). Welds shall be full penetration welds for full structural load capacity. For micropiles with bending or tension stress, welds shall be Ultrasonic (UT) or Radiograph Tested (RT). These requirements do not apply to minor welding that does not carry structural load, such as cutting teeth and tacking on bearing plates.
    - c. If significant tension loads are being considered, the Department will require the Contractor to provide data demonstrating the adequacy of the proposed detail.
    - d. The design shall limit the maximum yield stress of steel (Fy) to 87 ksi.
- C. Bar Reinforcement.** Provide Bar reinforcement meeting the requirements of §709-01, Bar Reinforcement Grade 60, or continuously threaded "Uncoated High-Strength Steel Bars for Prestressing Concrete" - ASTM A722.
- D. Grout.** Provide a pumpable grout consisting of, as a minimum, Portland Cement - Type 2 and Water meeting the following Specification requirements:

Material	Subsection
Portland Cement, Type 2	§701-01
Grout Sand	§703-04
Fly Ash	§711-10
Water	§712-01

The use of Grout Sand and Fly Ash in the mix is optional. Field sampling and testing shall be done in accordance with the current procedural directives of the Materials Bureau of the Office of Technical Services.

- E. Centralizers and Spacers.** Provide centralizers and spacers fabricated from schedule 40 PVC pipe, tube, steel, or material non-detrimental to the reinforcing steel. Wood shall not be used.
- F. Furnishing Equipment for Installing Micropiles.** None Specified
- G. Permanent Casing.** Permanent casing shall be of flush-joint or welded type and shall be of appropriate thickness to withstand the stresses associated with advancing it into the ground. Provide permanent casing as indicated in the contract documents and conforming to ASTM A252. Mill secondaries cannot be used for permanent casings.

Approval of the structural casing shall be done in accordance with the following procedure:

- 1. Requirements for Micropile Permanent Casing.** Structural casing that is installed in coupled (spliced) sections shall meet §551-2.02 B.1. *Requirements for Micropile Structural Casing*
- H. Water.** Provide water conforming to §712-01 Water for any drilling fluid.
- I. Static Pile Compressive Load Test (if Required).** Provide materials as required in Geotechnical Control Procedure (GCP-18) *Static Pile Compressive Load Test Manual*.

### 551-2.03 Drilled Shafts

Refer to the contract documents to determine which of the following materials will be required. For all steel remaining as a permanent part of the work, all Buy America provisions shall apply.

- A. Permanent Casing.** Provide continuous permanent casing conforming to the limits shown in the contract documents.  
Provide material conforming to the requirements of ASTM A252 Grade 2, unless specified otherwise in the contract documents. Furnish full length shells, consistent with requirements shown in contract documents.  
If needed, equip casing with an appropriate casing shoe to enable installation of casing to the elevations shown in the contract documents.
- B. Interim Casing.** Provide interim casing capable of withstanding all handling and installation stresses. If needed, equip casing with an appropriate casing shoe to enable installation of casing to the depths necessary to construct the drilled shaft to the elevations shown in the contract documents.

- C. Temporary Casing.** Provide temporary casing capable of withstanding all handling and installation and extraction stresses. If needed, equip casing with an appropriate casing shoe to enable installation of casing to the depths necessary to construct the drilled shaft to the elevations shown in the contract documents.
- D. Reinforcing Steel.** Provide bar reinforcement meeting the requirements of §709-01 *Bar Reinforcement, Grade 60* or ASTM A615 *Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*.
- E. Concrete.** Provide concrete conforming to the requirements of Section 501 *Portland Cement Concrete - General*, Class GG, as presented in Table 501-3 *Concrete Mixtures*. The Contractor is allowed the option of using admixtures to increase the slump to a maximum of 9 inches, provided all other mixture requirements set forth in Table 503-1 are achieved.
- F. Centralizers.** Provide centralizers for properly aligning the steel reinforcement, made of a material that is not detrimental to the reinforcement or the concrete. The type of centralizer utilized must be approved by the DCES.
- G. Rebar Cage Feet.** Provide cylindrical feet to support the rebar cage at the proper elevation, made of a material that is not detrimental to the reinforcement or concrete. The type of feet utilized must be approved by the DCES.
- H. Protective Coating for Permanent Casing.** Provide a Coal Tar Epoxy-Polyimide Coating meeting the requirements of, and apply it in accordance with, SSPC-PS 11.01: Black (or Dark Red) Coal Tar Polyimide Painting System. Apply the coating between the limits shown in the contract documents.
- I. Mineral Slurry.** Provide a mineral (bentonite) slurry that will remain in suspension, and with sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Provide a slurry with the percentage and specific gravity of the material used to make the suspension sufficient to maintain the stability of the excavation and to allow proper concrete placement.

The acceptable range of values for mineral slurry is as follows:

Range of Values (68°F)			
Property (Units)	Time of Slurry Introduction	Time of Concreting (In hole)	Test Method
Density (lb/ft <sup>3</sup> )	64.3 to 69.1	64.3 to 75.0	Density Balance
Viscosity (seconds/quart)	28 to 45	28 to 45	Marsh Cone
pH	8 to 11	8 to 11	pH paper or meter

Increase density range values by 2 pcf in salt water.

Desand the slurry so that the sand content does not exceed 4 percent (by volume) prior to concrete placement as determined by the American Petroleum Institute sand content test.

- J. Polymer Slurry.** Provide a polymer slurry with sufficient viscosity and gel characteristics to hold the hole open, and transport excavated material to a suitable screening system. Polymer



slurry may be made from PHPA (emulsified), vinyl (dry), or natural polymers. Desand the polymer slurry so that the sand content is less than 1 percent (by volume) prior to concrete placement, as determined by the American Petroleum Institute sand content test.

**K. Water.** Provide water conforming to the requirements of §712-01 *Water*, except with a pH conforming to the slurry requirements listed above.

**L. Furnishing Equipment for Installing Drilled Shafts.** None Specified.

**M. Crosshole Sonic Logging (CSL) of Drilled Shafts.** Provide access pipes for the testing equipment.

**1. Access Pipes.** Provide access pipes with the material and dimensions specified in the contract documents. Provide pipes with a round and constant internal diameter free of defects or obstructions, including any at pipe joints. Use watertight pipes free from corrosion with clean internal and external surfaces. Equip each pipe with a watertight threaded cap on the bottom and a removable threaded cap on the top.

**2. Grout.** Provide cement or sand-cement grout for filling access pipes. The Contractor's proposed grouting methods and grout mixes are subject to the approval of the Engineer. All grout constituents must meet the material requirements of §700 *Materials and Manufacturing*.

**3. Water.** Provide water that meets the requirements of §712-01 *Water*.

**N. Static Pile Compressive Load Test (if Required).** Provide materials as required in Geotechnical Control Procedure (GCP-18) *Static Pile Compressive Load Test Manual*.

## 551-3 CONSTRUCTION DETAILS

### 551-3.01 Piles

**A. General.** The method of storing and handling of piles shall be such as to avoid damage to the piles. Piles shall not be driven until after the excavation is completed to the elevation required for the bottom of the footing or bottom of tremie. Unless otherwise shown in the contract documents, any material forced up or depressions made by the driving shall be removed or filled and the correct elevation of foundation established before any concrete is placed.

The driving of piles shall be done with an air/steam, diesel, or hydraulic hammer. Piles shall be driven starting from the center of the foundation and proceeding outward from this point or starting at the outside row and driving progressively across the foundation.

The length of piles will be determined in the field by driving to the driving criteria determined by the DCES. Piles may be completely driven in one operation or, if directed by the DCES, be partially driven and allowed to set from 2 to 24 hours (or as indicated in the contract documents) before driving is resumed.

Piles shall be vertical or accurately battered as indicated in the contract documents. The top of any pile driven its full length into the ground shall not vary from the plan location by more than 4 inches, unless otherwise shown in the contract documents. The top of any pile partially exposed or included in an integral abutment shall not vary from the plan location by more than 1 inch, unless otherwise shown in the contract documents. Piles may have a variation at their tip of not more than ¼ inch per foot from the vertical or from the batter shown in the contract documents or permitted by the DCES.

All piles forced up by any cause shall be driven again, at no additional cost to the State. The following shall be causes for rejection of a pile:

- Pile location or batter is incorrect.
- Pile damaged from any cause whatsoever.
- Pile fails to attain the driving resistance determined by the DCES, or the driving resistance set forth in the contract documents.
- Pile tip elevation is not within the limits called for in the contract documents.
- Pile is unserviceable for other reasons related to the furnishing and installing of the pile.
- Cast-In-Place Concrete Pile Casing not free from water.

No footing concrete shall be placed until all piles within the footing are inspected by the Engineer. The Contractor shall remove rejected piles, or at the option of the Department, a second pile may be driven adjacent thereto if this can be done without impairing the structure.

The tops of all piles and pile casings shall be cut off at the elevation indicated in the contract documents, or as established by the Engineer. The cut shall be clean, level, and to a true plane, in accordance with the detail shown in the contract documents.

All cavities left by the pile driving operation shall be backfilled.

**B. Steel H-Piles.** Steel H-Piles shall be furnished with a shoe, fabricated as detailed in the contract documents, or as approved by the DCES. Substitution of commercial shoes for those detailed in the contract documents may be permitted subject to the approval of the DCES. Unless shown in the contract documents, the shoes shall be attached by a NYSDOT Certified Welder with a 5/16 inch minimum fillet weld along the entire outside edge of the flanges.

**C. Cast-In-Place Concrete Piles.** Pile casings which do not hold their original form during driving, which fracture, or fail during driving due to manufacturer defect, fabrication, or Contractor's operations, unless otherwise directed, shall be replaced at no additional cost to the State. If, at any time during the driving or placing of the pile casings, the DCES determines from the results of the driving that the pile casings of the type or thickness being used cannot be satisfactorily placed, the Contractor shall remove the casings, and replace them with casings of the type and thickness directed at the expense of the State.

All pile casings shall be equipped with a toe treatment as shown in the contract documents.

Cast-in-place concrete piles shall be reinforced as shown in the contract documents and the reinforcement secured in such a manner as to ensure its proper location in the finished piles.

Cast-in-place concrete pile casings shall be inspected immediately prior to placing concrete in the casing. All casings in the footing shall be satisfactorily placed and dry before concrete is placed. Each casing shall be filled with a continuous pour of Class A concrete, mixed and placed in accordance with Section 555 *Structural Concrete*. Cold joints are not allowed.

Care shall be exercised in filling the piles to prevent honeycomb and air pockets from forming in the concrete. Internal vibrators and other means shall be used to the maximum depth practicable to consolidate the concrete.

All exposed pile or pile casing surfaces not embedded in concrete shall be painted in accordance with the Contract Documents.

**D. Furnishing Equipment for Driving Piles.** The Contractor shall submit to the DCES for approval Form BD 138 *Pile Driving Equipment Data* a minimum of 21 calendar days prior to beginning pile driving work. Each separate combination of pile and pile driving equipment proposed by the Contractor shall require the submission of a corresponding Form BD 138.

Piles shall be driven only with equipment which has the prior approval of the DCES. All malfunctioning equipment shall be removed from the site and be replaced with equipment which

is satisfactory to the DCES. The minimum rated striking energy of the hammer to be used in driving Steel H-Piles and Cast-In-Place Concrete Piles shall be 13 kip-feet per blow.

Hammers having greater striking energy may be used upon approval by the DCES. These hammers shall produce a minimum of 20 blows/foot and a maximum of 120 blows/foot at the Nominal Pile Resistance shown in the contract documents. However, if, in the opinion of the DCES, satisfactory results are not obtained with the hammer furnished by the Contractor, a hammer meeting the approval of the DCES shall be furnished and used.

Water jets and vibratory hammers shall not be used in driving any pile unless written approval is given by the DCES. Piles installed with a water jet or vibratory hammer shall be impact driven to secure the final penetration.

**1. Air/Steam Hammers.** Sufficient boiler or compressor capacity shall be provided at all times to maintain the rated speed of air/steam hammers during the full time of pile driving. The valve mechanism and other parts of a single or double-acting hammer shall be maintained such that the number of blows per minute for which the hammer is designated, is satisfied.

**2. Diesel Hammers.** Single acting hammers' valves, pumps, ports, rings, and other hammer parts shall be maintained such that the length of stroke, or blows per minute, is satisfied.

All diesel hammers shall be provided with an acceptable means of measuring hammer energy.

**3. Hydraulic Hammers.** Hydraulic hammers that have enclosed rams, shall be equipped with an electronic printout. Those which have exposed rams, shall be visually inspected.

**4. Hammer Cushion.** An approved hammer cushion block shall be used to transfer pile hammer energy to the pile. Each hammer shall be equipped with a helmet/drive head to fit the type of pile to be driven.

The hammer cushion will be inspected for compliance with the description in the BD 138 prior to driving the first pile, and thereafter every 100 hours of driving. The hammer cushion will be re-inspected if a hammer with a different serial number is brought to the project.

**5. Pile Driving Leads.** Pile driving leads shall be constructed in such a manner as to afford freedom of movement of the hammer. The use of either swinging or hanging leads will be permitted provided the pile or leads are properly supported during driving and the required final position and batter of pile is achieved. If the use of swinging or hanging leads produces unsatisfactory results, the Contractor shall hold the leads in position with guys or braces to give the required support or use equipment having fixed leads.

Pile driving leads shall be of sufficient length so that the use of a follower will not be necessary. The driving of piles with followers will generally not be permitted and shall be done only with written permission and direction of the DCES.

When directed by the Engineer, approved steel spuds shall be used to penetrate consolidated material or obstructions in the upper 10 feet in order to assist in driving the piles to the required depth and resistance. Augers may be used for this purpose with written approval from the DCES.

**E. Dynamic Pile Load Testing.** Dynamic pile load tests will be conducted by the Department under the direction of the DCES. The Contractor shall furnish a source of electrical power, a suitable test enclosure to perform field testing of piles and evaluate pile hammer efficiency and all incidental labor and material necessary to make the work area accessible.

Tests shall be performed at the locations indicated in the contract documents and where directed by the Engineer. A Dynamic Pile Load Testing Procedure, known as the "Impact Driving Method", will be used. This procedure entails the following steps:

1. Prior to being struck with the pile driving hammer, each pile to be tested will be instrumented with strain and acceleration transducers by State personnel, aided by the Contractor's forces.
2. Dynamic measurements resulting from the pile hammer blows will be automatically recorded on a pile driving analyzer supplied by the State and operated by State personnel.
3. Upon determination by the Engineer that valid data has been recorded, State personnel, assisted by the Contractor's forces, will remove the instrumentation.

The Contractor will schedule equipment movements to ensure that testing is done as part of the normal driving schedule, insofar as it is possible.

**F. Static Pile Compressive Load Test (if Required).** Provide all testing, materials, and services as identified in §551-3.02 C. *Static Pile Compressive Load Test (if Required)*.

**G. Splices.** Full length piles shall always be used where practicable. Pile splices shall be constructed as shown in the contract documents, or as approved by the DCES. Where splices are unavoidable, their number, locations, and details will be subject to the approval of the DCES. Pile splices at less than 10 feet beyond the estimated length shall be installed at no additional cost to the State. A second splice may be used at 30 feet beyond the estimated length, subject to DCES approval.

Splices to steel H-Piles, and steel pile casings shall be welded in conformance with the provisions of the Steel Construction Manual (SCM) These requirements include, but are not limited to, a NYS certified welder and a DCES approved welding procedure.

Where design considerations and soil characteristics permit, the DCES may approve the use of a mechanical splice in lieu of a welded splice. The mechanical couplings used for such splices shall be subject to the provisions of §715-01 *Structural Steel*. A seal weld shall be provided completely around the pile casing.

**551-3.02 Micropiles.** Progress all micropiles using steel drill casing.

**Micropiles (Design Provided).** Engage a Professional Engineer to design the micropiles in accordance with NYSDOT LRFD Bridge Design Specifications Article 10.9 *Micropiles* for LRFD design and FHWA's *Micropile Design and Construction, Reference Manual*, Publication No. FHWA-NHI-05-039 for ASD design. The Contractor's Engineer shall design the micropiles to perform satisfactorily for both structural and geotechnical requirements. The Contractor's Engineer shall design the diameter, length, reinforcement, micropile connections, grout strengths, and grouting pressures, and select the equipment, procedures and methods so that each micropile meets the micropile acceptance criteria, can provide the required structural and geotechnical resistances, and meet other requirements indicated in the contract documents.

**A. Prior Experience.** The Contractor performing the work described in this specification for Micropiles (Contractor Designed) or Micropiles (Design Provided) shall submit proof of the following:

1. Experience in the construction and load testing of micropiles, having successfully constructed at least 5 projects in the last 5 years involving construction totaling at least 100 micropiles of similar resistances to those required in the contract documents.

2. The proposed On-Site Supervisor for this work having supervised the successful installation of micropiles on at least 3 projects of similar scope over the past 5 years.

**B. Design and Installation Submittals.** Submit the design and method-of-installation information outlined below to the Engineer for approval by the Deputy Chief Engineer Structures (DCES). The DCES will require 20 work days to review the submittal. Do not begin work prior to receiving approval by the DCES. Approval of the installation method by the DCES does not constitute a guarantee of acceptable micropile installations. Acceptable installations are the responsibility of the Contractor.

Include in the submittal (for Micropiles (Design Provided) projects, omit 1. Micropile computations):

1. Micropile computations and details for each required load case including, but not limited to, nominal diameter, length, reinforcement, micropile connections, post grout tube and grouting pressures.
2. Details of equipment for micropile installation.
3. Details of the general procedures for micropile installation including, but not limited to, installation sequence and the approximate time required for each sequence step. Actual sequence will be agreed to in the field with the Engineer based on field conditions at the time of installation.
4. Procedures for advancing through boulders and other obstructions.
5. Procedures for containment of drilling fluid and spoil, and disposal of spoil.
6. Where applicable, drawings that show the specific work can be performed under limited headroom conditions and as close to obstructions, as site conditions warrant, to install the micropiles at the locations indicated in the contract documents. Provide information on the length of the casing sections to be used, as dictated by the length of the drill mast and by the available overhead clearance, and the resulting location of joints.
7. When steel drill casing/pipe is used as reinforcement, account for the reduced area of the threaded joint in the structural design of the micropile, particularly for resistance in tension and bending. Identify any joint location restrictions that must be followed in construction.
8. Procedures and equipment for placing grout.
  - a. Prepare the mix design for the grout and obtain documentation from an independent laboratory showing the following:
    - i. The mix design conforms to the submitted mix and meets the strength requirements set by the Contractor.
    - ii. The compressive strength of the mix, tested at 3, 7, 14, and 28 days.
    - iii. The specific gravity of the mix.
  - b. Identify a method for monitoring quality control of the mix. At a minimum, the Contractor shall use a Baroid Mud Balance per American Petroleum Institute (API) Recommended Practice (RP) 13B-1: Standard Procedure for Testing Water-Based Drilling Fluids, to check the specific gravity of the mixed grout prior to placement of the grout into each micropile.
  - c. Provide pressure gages capable of measuring the actual grout pressures used and such that actual pressure readings are within the middle third of the gage's range.
  - d. Methods and equipment for accurately monitoring and recording the grout volume and grout pressure as the grout is being placed.
9. If proposed, details of post-grouting equipment and procedures, including the method, sequence of operations and equipment required.
10. Layout drawings showing the proposed sequence of micropile installation. Coordinate this sequence with the proposed phasing and scheduling.

**Permanent Casing Submittals (if Required).** Submit the following information in accordance with the requirements in the contract documents to the Engineer for approval by the Deputy Chief Engineer Structures (DCES). The DCES will require 20 work days for review.

Include in the submittal:

1. Details of equipment for permanent casing installation.
2. Details of procedures for permanent casing installation.
3. Procedures for advancing through boulders and other obstructions.
4. Procedures for containment of drilling fluid and spoil and disposal of spoil.
5. Where applicable, drawings that show the specific work can be performed under limited headroom conditions and as close to obstructions, as site conditions warrant, to install the permanent casing at the locations and to the depths indicated in the contract documents. Provide information on the length of the casing sections to be used, as dictated by the length of the drill mast and by the available overhead clearance and the resulting location of joints.
6. Layout drawings which show the proposed sequence of permanent casing installation and how it will be coordinated with micropile installation.

**C. Static Pile Compressive Load Test (if Required).** Furnish all testing materials and equipment and perform a static pile compressive load test on the micropile indicated in the contract documents. The work shall be done in accordance with the requirements of Geotechnical Control Procedure (GCP-18) *Static Pile Compressive Load Test Manual*.

Engage the services of a Professional Engineer, experienced in all aspects of pile load testing and acceptable to the Deputy Chief Engineer Structures to perform the load tests and to prepare reports of test results, as outlined in GCP-18. The Contractor's agreement with the Professional Engineer shall provide for additional technically qualified personnel to be at the test site at all times during testing to assure that loads are being maintained and to record data.

In instances where the micropile being tested is a Contractor Designed Micropile, the work shall also include the installation of the test pile.

The micropile shall be tested in accordance with the requirements of GCP-18.

**D. Furnishing Equipment for Installing Micropiles.** Submit literature fully describing the type of equipment proposed for use to the Engineer for approval by the Deputy Chief Engineer Structures, at least 30 days prior to commencing installation. At any time, remove all equipment deemed unsatisfactory by the Engineer from the site and replace it with satisfactory equipment at no additional cost to the State.

**E. Permanent Casing Installation and Soil Removal (if Required).** Install the permanent casing prior to or in conjunction with the micropile installation. Install the permanent casing so that the center of each casing does not vary from the plan location by more than 3 inches. Do not allow the permanent casing to vary from the vertical or established batter by more than 1/4 inch per foot as measured above ground. Install the top of the permanent casing to the elevation indicated in the contract documents.

Advance the hole using a duplex drilling method. Do not drill or flush ahead of the drill casing by more than 1 foot. Perform drilling and excavation in such a manner as to prevent the collapse of the hole. Use of bentonite slurry is not permitted. Use of polymer slurry to remove cuttings from the cased hole must be approved by the Engineer.

If obstructions are encountered during excavation for a permanent casing, progress through them by means of coring or a tricone roller bit. Use of drop-type impact hammers or blasting is not permitted. Use of a down-the-hole hammer must be approved by the DCES.

Control the procedures and operations so as to prevent mining, damage or settlement to adjacent structures, tunnels, utilities, or adjacent ground. If any mining, damage, or settlement occurs, halt operations. Provide a written plan with procedures to avoid reoccurrence to the

Engineer for review. Resume work only after the Engineer has approved the plan in writing. Repair all damage and settlement at no additional cost to the State.

Control the procedures and operations so as to prevent the soil at the bottom of the hole from flowing into the hole at all times during installation and cleaning out.

Control drilling fluid and dispose of spoil in accordance with the approved procedure.

Fill annular space between the permanent casing and the micropile with the grout meeting the requirements of the approved mix design.

- F. Drilling and Excavation.** Advance the hole using a duplex drilling method. Do not drill or flush ahead of the drill casing by more than 1 foot. Perform drilling and excavation in such a manner as to prevent the collapse of the hole. Use of bentonite slurry is not permitted. Use of polymer slurry to remove cuttings from the cased hole must be approved by the Engineer.

If obstructions are encountered during excavation for a micropile, progress through them by means of coring or a tricone roller bit or other approved method. Use of drop type impact hammers and blasting are not permitted. Use of a down-the-hole hammer may only be used when approved by the DCES.

Control the procedures and operations so as to prevent mining, damage or settlement to adjacent structures, tunnels, utilities, or adjacent ground. If any mining, damage, or settlement occurs, halt operations. Provide a written plan to the Engineer for review with procedures to avoid reoccurrence. Resume work only after the Engineer has approved the plan in writing. Repair all damage and settlement at no additional cost to the State.

Control the procedures and operations so as to prevent the soil at the bottom of the hole from flowing into the hole at all times during installation and cleaning out. Monitor the rate of fluid flow used to progress the holes.

Control drilling fluid and dispose of spoil in accordance with the approved procedure.

Do not progress a hole, pressure grout, or post-grout, within a radius of 5 micropile diameters or 5 feet, whichever is greater, of a micropile until the grout for that micropile has set for 24 hours or longer if a retarder is used.

- G. Micropiles with Extended Lengths (if Required).** Design and install micropiles with extended lengths at the locations shown in the contract documents. The specified tension and compression resistance derived from the soil and/or bedrock will be achieved below the elevations indicated in the contract documents.

- H. Reinforcement and Post Grout Tube Placement.** Provide centralizers sized to position the reinforcement within  $\frac{3}{4}$  inches of plan location from the center of the micropile; sized to allow grout tremie pipe insertion to the bottom of the drillhole; and sized to allow grout to freely flow up the drill hole and casing and between adjacent reinforcing bars. Centralizers, spaced not to exceed 10 feet, must be used to center the reinforcement for its entire length. Securely attach the centralizers to withstand installation stresses. Do not drop but lower the steel reinforcement to its specified location in the hole. If a post grout tube is used, attach it to the steel reinforcement prior to lowering it.

- I. Grout Placement and Casing Removal.** Provide quality control of the mix by monitoring grout quality. Measure grout consistency by determining grout density per API Recommended Practice (RP) 13B-1 by the *Baroid Mud Balance Test* at a frequency, of at least one test per micropile, and provide the information to the inspector.

The Engineer will perform quality assurance of the mix in accordance with the Geotechnical Engineering Manual (GEM-25) *Micropile Inspector Guidelines* and the Materials Test Method No. NY 701-19E *Grout Cube Molding Procedure*.

Place grout by means of a tremie pipe from the bottom of the micropile upward. Place grout in one continuous operation to the top of the micropile. Cold joints are not allowed. Record the initial volume of grout required to fill the hole. Record grouting pressure and volume of grout being pumped into the micropile during pressure grouting. Upon completion, maintain the grout level at or above the micropile cut off elevation until the grout has set.

Locate the grout pressure and volume measuring gages at the micropile installation site so that they are accessible and legible to the inspector.

**J. Post Grouting.** Provide the equipment and materials to perform post grouting. Perform post grouting after the grout has reached initial set. Record the pressure at which the grout was pumped, the total volume pumped, and the volume pumped through each port (if applicable).

**K. Construction Tolerances.** Install the micropiles so that the center of each micropile does not vary from the plan location by more than 3 inches. Do not allow the micropile to vary from the vertical or established batter by more than 1/4 inch per foot, as measured above ground.

Cut off the top of the micropile at the elevation indicated in the contract documents.

If the soil at the micropile tip is post grouted, monitor the elevation of the micropile top during post grouting. If movement occurs, the Engineer will immediately notify the DCES.

**L. Micropile Acceptance Criteria**

1. Micropile meets Construction Tolerance criteria.
2. Micropile was installed in accordance with the approved submittal.
3. Micropile is not damaged.
4. Micropile was installed using the same method, grout volumes, and pressures as the accepted test pile, if applicable.

**M. Unacceptable Micropiles.** Unacceptable micropiles are micropiles which do not meet the acceptance criteria identified in §551-3.02 L. *Micropile Acceptance Criteria*.

Submit to the Engineer a written plan of remedial action, for approval by the DCES, showing how to correct the problem and prevent its reoccurrence. Repair, augment, or replace the unacceptable micropile in accordance with the approved remedial plan at no additional cost to the State.

### 551-3.03 Drilled Shafts

**A. Prior Experience.** Submit proof and details of the following:

1. Two projects in the past 5 years where the Contractor or subcontractor performing the work has successfully installed drilled shafts similar to the size and type on this project.
2. The foreman for this work having supervised the successful installation of drilled shafts on at least two projects in the last 2 years.
3. The drill operators having had at least one year of experience installing drilled shafts with similar diameters and lengths, and in similar conditions.

Include details describing the equipment and methods used, any difficulties encountered and how they were overcome, and the results of any testing performed. Include the name and telephone number of someone for each project cited who can be contacted as a reference. Submit this information to the DCES for review, evaluation, and approval prior to submitting detailed information as stated in this specification under C. Submittals. The DCES will render a decision within 15 working days after the receipt of all information. A Contractor or subcontractor will not be permitted to install drilled shafts without this approval.



All approvals are subject to trial and satisfactory field performance. Departmental approval does not relieve the Contractor or subcontractor of his responsibility to satisfactorily complete the work detailed in the contract documents.

## **B. Furnishing Equipment for Installing Drilled Shafts.**

- 1. General** Provide the equipment and use procedures necessary to install drilled shafts at the locations and to the elevations shown in the contract documents, or as approved by the DCES.

Prior to preparing submittals, fully examine the existing site conditions and subsurface exploration logs.

The construction methods selected are directly related to the method of load transfer assumed in the project design. The type of drilling method, presence of permanent or interim casing, and clean out procedure all affect the drilled shaft load transfer behavior in skin friction and end bearing. Construct the drilled shafts using construction methods consistent with the load transfer mechanism shown in the contract documents.

- 2. Type.** Prior to delivering any equipment to the site, submit the proposed type of equipment for drilled shaft installation to the Deputy Chief Engineer Structures (DCES) for review and approval. The DCES will render a decision within 15 working days, measured from the date of receipt of all information.

Provide equipment capable of installing drilled shafts with lengths 20% greater than those shown in the contract documents. Provide equipment capable of accessing holes on water and progressing holes through soils at the site which may include miscellaneous fill, boulders, timber, and other obstructions, and into bedrock. Remove all equipment from the site deemed unsatisfactory by the DCES and replace it with satisfactory equipment at no additional cost to the State.

Provide equipment capable of installing drilled shafts, given the low overhead clearance conditions at the site.

- C. Submittals.** Submit the proposed procedure and equipment for installing drilled shafts to the DCES for review and approval prior to commencing the work. The DCES will render a decision within 15 working days, measured from the date of receipt of all pertinent information. The submittal should include, but not be limited to, the following information:

1. Method describing how the Contractor will progress through obstructions and rock.
2. Details and method describing how the Contractor will keep the hole for the drilled shaft open.
3. Drawings showing and details describing the proposed sequence of drilled shaft installation. Include the sequence for each shaft, the overall construction sequence, and the sequence of shaft construction in bents or groups.
4. Information describing the type of equipment to be used, including drill rig, cranes, drilling tools, final cleaning equipment, desanding equipment, slurry pumps, sampling equipment, tremie or concrete pumps, casing (including casing dimensions, material, and splice details), etc.
5. Proposed method for cleaning out the shaft excavations. Include a description of how the Contractor will perform spoil removal and disposal.
6. Documentation that shows that the Contractor, Driller, and Foreman have the requisite prior experience in installing drilled shafts. Include the name and telephone number of someone for each project cited who can be contacted as a reference.
7. Shaft excavation methods, and final shaft dimensions.

8. If slurry is to be used, indicate the method proposed to mix, circulate, and desand the slurry. Include methods of slurry disposal in the submittal.
9. Method of reinforcement placement, including support and centralization type and methods.
10. Details and method of concrete placement, curing, and protection.
11. If the concrete mix is modified (i.e., retarders), include the new mix design, and test results of cylinder breaks from an independent laboratory. Also, include test results that demonstrate a slump loss versus time relationship.
12. A description and details of the slurry sampling tool to be used. Provide a tool capable of taking a slurry sample at a specific depth, without being contaminated by slurry from another depth.
13. When slurry is used, include an alternate procedure to be used which will secure the shaft in the event of slurry loss.
14. A description of the type of feet to be used to support the rebar cage in the drilled shaft.
15. An emergency construction joint procedure, to be used in the event when concrete placement for the drilled shaft is unexpectedly interrupted.
16. A procedure for filling voids between permanent or interim casing and the soil.
17. A description of equipment and methods to be used for drilled shaft inspection. The Inspector will use these methods and equipment to inspect the drilled shafts. The inspection program must be thorough enough to assure the Department that each drilled shaft meets the requirements contained in this specification.

Do not begin work until the DCES has issued all approvals.

#### **D. Construction Tolerances**

1. The allowable tolerance from plan location is 3 inches at the top of shaft elevation. Measure the as-drilled center of shaft using reference stakes offset from the shaft excavation.
2. The allowable tolerance from the required verticality is 2%. For battered shafts, the allowable tolerance from the required batter is 3%. This tolerance applies for the total length of shaft.
3. Cutoff elevation tolerance is plus 1 inch to minus 3 inches from the top of shaft elevation shown in the contract documents.
4. Rebar stick up elevation tolerance, after all shaft concrete has been placed, is plus or minus 2 inches from the stick-up elevation shown in the contract documents.
5. The bottom of the shaft excavation is perpendicular to the axis of the shaft, within a tolerance of  $\frac{3}{4}$  inch per foot of shaft diameter.
6. Tolerances for the diameter are as follows:
  - a. The minimum diameter of the drilled shaft is not more than 1 inch less than the diameter shown in the contract documents.
  - b. The maximum shaft diameter is the diameter shown in the contract documents plus 6 inches. Verify the diameter for the entire length of the shaft using devices constructed of a rigid rod with four 90° offset rods.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. Submit written correction procedures to the DCES through the Engineer for approval prior to correcting the deficiencies. The Contractor is responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer at no cost to the State.

#### **E. Drilling and Excavation**

- 1. General.** When drilled shafts are to be constructed in conjunction with embankment placement, construct shafts after placement of the fill, unless otherwise shown in the contract documents.

The Contractor is responsible for reviewing all the subsurface and site information, and limitations, for the project.

- 2. Trial Shafts.** Construct trial shaft(s) in accordance with the same methods submitted and approved for production drilled shaft installation. The purpose of the trial shaft installation is to demonstrate the adequacy of the Contractor's proposed methods and equipment for excavating the drilled shafts.

Construct trial shaft(s) in the area(s) designated in the contract documents, or as directed in writing by the Engineer. Progress the trial shaft(s) to the depth shown in the contract documents.

Progress the holes for the trial shaft(s) to the required elevation(s) in such a manner so as not to cause disturbance or settlement to the surrounding ground surface or adjacent structures. If any disturbance occurs, halt operations and modify the equipment and/or procedures so as not to cause any further disturbance. Submit the modified drilled shaft installation procedure, in writing, to the DCES through the Engineer. After receiving approval from the DCES, repair any damage at no cost to the State, and proceed.

During drilling or excavation of the shaft(s), make frequent checks of the plumbness, alignment, and dimensions of the shaft. Correct any deviations exceeding the allowable tolerances using a procedure approved by the Engineer.

Clean the inside of the holes for the trial shaft(s) to the diameters and depths called for in the contract documents. Dispose of all excavated material in accordance with Section 203 *Excavation and Embankment*.

After the trial shaft(s) have been excavated, inspected, and accepted, remove any casing used and backfill the hole(s) with unreinforced concrete. Cut off the completed trial shaft(s) 2 feet below finished grade. Restore the disturbed areas in the vicinity of the trial shaft(s) as nearly as possible to their original condition.

Failure of the Contractor to demonstrate the adequacy of methods and/or equipment to the Engineer constitutes reason for the Engineer to require alterations in methods and/or equipment. Construct any additional trial shaft(s) necessary to achieve satisfactory results at no additional cost to the State, as ordered by the Engineer.

- 3. Drilled Shafts and Drilled Shafts (Low Overhead Clearance).** Excavate the holes and dispose of all excavated material for production drilled shafts using the same requirements, methods, procedures, and equipment used to satisfactorily excavate trial shaft(s), if trial shafts were used. Otherwise, use the same methods approved by the DCES. Do not alter equipment and/or methods without written permission by the DCES.

Where drilled shafts are located in open water areas, extend exterior casings (temporary, interim, or permanent) from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing of the concrete. Install the exterior casing in such a manner so as to produce a positive seal at the bottom of the casing and prevent piping of water or other materials into or from the shaft excavation.

Do not keep mineral slurry in the holes while drilling rock sockets, as it has a detrimental effect on the concrete-to-rock bond.

- 4. Dry Construction Method.** This method will only be permitted at sites where all of the following apply:
  - a. The groundwater table and site conditions are suitable to permit construction of the shaft in a relatively dry excavation.

- b. Where the sides and bottom of the shaft remain stable without any caving, sloughing, or swelling.
- c. Where the sides and bottom of the shaft can be visually inspected prior to placing the rebar cage and concrete.

A “relatively dry” excavation is one where the infiltration rate does not exceed 12 inches of water in one hour. Perform all operations so that less than 2 inches of water remain at the bottom of the excavation at the time of concreting.

- 5. Wet Construction Method.** The wet construction method may be used at sites where a dry excavation cannot be maintained for placement of the shaft concrete. This procedure may require cleaning the slurry, and final cleaning of the excavation by means of a bailing bucket, air lift, submersible pump, or other devices.

Maintain a minimum slurry level of 4 feet above the highest groundwater level encountered on the project.

Provide surface casings to aid shaft alignment and position, and to prevent sloughing of the top of the shaft excavation, unless it is demonstrated to the satisfaction of the Engineer that the surface casing is not required.

- 6. Temporary Casing Construction Method.** Use this method at sites where the stability of the excavated hole and/or the effects of groundwater cannot be controlled by other means. Install temporary casing using rotating, oscillating, driving, or vibratory methods unless methods are required or limited in the contract documents. Install temporary casing in advance of the excavation to the lower limits of the caving material.

Remove temporary casing while the concrete is still workable. As the casing is withdrawn, maintain a 5 foot minimum head of fresh concrete in the casing so that all fluid trapped behind the casing is displaced upward without contaminating the shaft concrete. Extract the casing at a slow, uniform rate, with the pull in line with the axis of the casing.

- 7. Interim Casing Construction Method.** Use this method at sites where the stability of the excavated hole and/or the effects of groundwater cannot be controlled by other means. Install interim casing using rotating, oscillating, driving, or vibratory methods unless methods are required or limited in the contract documents. If full penetration cannot be attained, the Contractor may either excavate material within the embedded portion of the casing or excavate a pilot hole ahead of the casing until the casing reaches the desired penetration. Progress the pilot hole centered in the shaft, and no larger than one-half the diameter of the shaft.

Progress the interim casing so that the casing maintains intimate contact with the soil.

- 8. Permanent Casing Construction Method.** This method generally consists of installing the permanent casing to a prescribed elevation prior to excavating. Install permanent casing using rotating, oscillating, driving, or vibratory methods unless methods are required or limited in the contract documents. If full penetration cannot be attained, the Contractor may either excavate material within the embedded portion of the casing or excavate a pilot hole ahead of the casing until the casing reaches the desired penetration. Progress the pilot hole centered in the shaft, and no larger than one-half the diameter of the shaft.

Progress the permanent casing so that the casing maintains intimate contact with the soil.

- 9. Slurry.** Pre-mix the slurry and allow adequate time for hydration prior to introduction into the shaft excavation. Provide adequate slurry tanks when specified or required by the

Engineer. Do not mix slurry in the hole for the drilled shaft. Slurry pits will not be allowed without written permission from the Engineer.

Provide adequate desanding equipment where required for slurry operations. Take appropriate steps to prevent slurry from “setting up” in the shaft excavation, such as agitation, circulation, and adjusting the properties of the slurry. Do not let the slurry sit unagitated for more than 4 hours. If the slurry is in the hole, unagitated for more than 4 hours, scrape the sides to remove the filter cake before proceeding with the excavation.

Perform control tests on the slurry to determine density, viscosity, and pH before and during shaft excavation to establish a consistent working pattern.

Let the slurry sit for 30 minutes prior to placing the rebar cage and shaft concrete, to allow the excess sand to settle out. Remove any sand and spoil that has accumulated on the bottom.

Immediately prior to placing shaft concrete, take slurry samples from the bottom and 10 feet from the bottom of the drilled shaft excavation using an approved slurry sampling tool. Remove any heavily contaminated slurry and spoil that has accumulated at the bottom of the shaft. Be sure the slurry is within the specification requirements immediately before concrete placement. If it is not, clean the hole and flush it with fresh slurry until subsequent tests reveal that the slurry is within the tolerances contained in this specification.

**10. Excavation Inspection.** Provide equipment for checking the dimensions and alignment of each shaft excavation. Determine the dimensions and alignment under the direction of the Engineer. Measure the final shaft depth after cleaning.

**F. Rock Sockets.** Progress rock sockets to the depth, diameter and elevations shown in the contract documents. If the top of socket elevation varies from that shown in the contract documents by more than 3 feet, notify the Engineer who will contact the DCES for a redesign.

**G. Quality Assurance Equipment Installation.** Install any quality assurance equipment prior to concreting the hole. This includes any pipes for crosshole sonic logging, and any other instrumentation.

**H. Rebar and Concrete Placement, and Temporary Casing Removal.** Place reinforcing and concrete within 2 hours after the drilled shaft has been excavated, cleaned out, inspected, and accepted by the Engineer.

Completely assemble the reinforcing steel cage, including longitudinal bars, ties, cage stiffener bars, centralizers, concrete feet, and other necessary appurtenances.

Place and center the rebar cage in the hole for the drilled shaft prior to concreting the shaft. Install centralizers at the bottom and along the axial length of the steel reinforcing at sufficient spacing to maintain proper concrete cover (minimum 3 inches), but at a spacing that does not exceed 10 feet. Place approved cylindrical feet (bottom supports) at the bottom of the cage to ensure that the bottom of the cage is maintained at the proper distance above the base.

Immediately prior to concreting, take depth measurements with a weighted tape. Clean out the hole if there is more than ½ inch of debris on the bottom for end-bearing shafts, and 2 inches of debris for side-friction shafts. If drilling mud is being used to support the hole, perform slurry contamination tests in accordance with the American Petroleum Institute’s (API’s) test *Standard Procedure for Field Testing Drilling Fluids*, API RP-13B. Adjust the slurry to meet contract specification requirements.

Check the elevation of the top of the rebar cage before and after placing the shaft concrete. If the rebar cage is not maintained within the specified tolerances, make corrections to the satisfaction of the Engineer. Do not construct additional shafts until the procedure has been modified, to the satisfaction of the Engineer.

For drilled shafts constructed using the Dry Construction Method, place concrete by tremie, pumping, or free-fall. When placing concrete by free-fall, direct the concrete so that it does not strike the sides of the excavation or the reinforcing cage.

For all other drilled shafts, place concrete in accordance with the requirements of §555-3.04 *Handling and Placing Concrete* and §555-3.05 *Depositing Structural Concrete Under Water* except place the concrete using the tremie method, by pumping, or by another method approved by the Engineer. Do not place concrete using free fall. Place concrete in one continuous operation to the top of the shaft. Cold joints are not allowed.

For shafts less than 8 feet in diameter, conduct operations so that the elapsed time from the beginning of concrete placement in the shaft to the completion of placement does not exceed 2 hours, unless an approved shaft concrete retarder is used. Proceed so that the concrete mix remains in a workable plastic state throughout the 2 hour placement limit.

When the top of shaft elevation is above ground, form the portion above ground with a removable form, or with permanent casing when specified.

Temporary casings which become bound during shaft construction and cannot be practically removed are unacceptable unless the Contractor can prove to the Department's satisfaction that the casing will not adversely affect the performance of the drilled shaft. Submit a procedure for correcting this to the Engineer for approval before conducting further work on the shaft.

Do not conduct any construction operations which may cause soil movement immediately adjacent (within 5 feet) to the drilled shaft for 24 hours after completing the shaft concrete pour.

Fill any voids between permanent or interim casing and the soil with concrete at least 48 hours after concreting the shaft.

**Pumped Concrete.** All provisions of §555-3.05 *Depositing Structural Concrete Under Water* shall apply.

**I. Crosshole Sonic Logging (CSL) of Drilled Shafts (if Required).** The selection of the testing organization is subject to the approval of the Deputy Chief Engineer Technical Services (DCETS).

**1. Equipment.** Provide CSL equipment which consists of the following components:

- a. A microprocessor based CSL system for display of individual CSL records, analog digital conversion and recording of CSL data, analysis of receiver responses and printing of CSL logs.
- b. Ultrasonic source and receiver probes for 1½ inch or 2 inch I.D. pipe, as appropriate.
- c. An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system.
- d. A measurement device to determine the depth of records.
- e. Appropriate filter/amplification and cable systems for CSL testing.

**2. Procedure**

- a. **Access Pipes.** Install the access pipes in the shafts specified to be tested as per the contract plans. The number of pipes per shaft and location of the pipes within the shaft is detailed on the plans. Secure the pipes to the rebar cage prior to the placement of the cage in the shaft.

After placement of the reinforcement cage, fill the pipes with water before or immediately after concrete placement and cap the pipe tops. The pipes shall be parallel to the longitudinal axis of shaft. Exercise care in the removal of caps from the pipes after installation of the shaft concrete so as not to apply excess stress that may break the bond between the pipes and the concrete.

- b. CSL Testing.** Provide the shaft toe and top elevations, along with construction dates to the testing organization prior to the CSL testing. Conduct CSL tests between pairs of pipes, in the pair configurations shown on the plans. Additional tests may be conducted in the event any anomalies are detected in the specified logs.

Remove slack from the cables prior to raising the probes to provide for accurate depth measurement in the CSL records. Raise the probes simultaneously, starting from the bottom of the access pipes. Take CSL measurements from the toe to the top of each shaft at intervals of 0.2 feet. Conduct the CSL testing with the source and receiver probes in the same horizontal plane unless test results indicate potential anomalies/defects in which case the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the pipes). Report anomalies/defects indicated by longer pulse arrival times and significantly lower energy/amplitude signals to the Engineer at the time of testing.

- c. Test Results.** Provide a preliminary report to the DCETS within two working days and a final report within five working days of completion of the testing at each substructure. Include in the test results CSL logs with analyses of:

- i. Initial pulse arrival time or compression wave velocity versus depth.
- ii. Pulse energy/amplitude versus depth.

Present a CSL log for each pipe pair tested and discuss any anomaly/defect zones in the report as appropriate.

In the event the Quality Assurance testing indicates voids or discontinuities in the concrete, which, as determined by the DCES, indicate that the drilled shaft is not structurally adequate, submit a written proposal for correcting the deficiencies and steps to prevent them from recurring to the Engineer for approval by the DCES. Do not continue working on the drilled shaft in question, or any other drilled shaft, until the DCES grants approval. Perform any additional QA verification work (such as full depth shaft coring) and/or corrective work necessary as a result of shaft defects at no additional cost to the State.

The repair procedure is subject to the approval of the Engineer. Additional CSL testing will be conducted at the Contractor's expense to verify the repair of the defects.

- d. Acceptance.** Upon completion of the CSL testing and acceptance of the drilled shafts by the DCETS, remove the water from the access pipes and fill the pipes to the top of the drilled shaft with a cement or sand-cement grout. Cut off the pipes flush with the top of the drilled shaft.

- J. Static Pile Compressive Load Test (if Required).** Provide all testing, materials, and services as identified in §551-3.02 C. *Static Pile Compressive Load Test (if Required)*.

## 551-4 METHOD OF MEASUREMENT

### 551-4.01 Piles

- A. General.** The length of piles will be determined in the field by driving to the resistance required by the Contract Documents, or DCES at the time of driving. The pile lengths indicated in the contract documents are for estimating purposes only.
- B. Steel H-Piles.** The quantity of Steel H-Piles to be measured for payment will be in feet of acceptable piles driven, measured to the nearest 1 foot below the cut off elevation.

- C. Cast-In-Place Concrete Piles.** The quantity of Cast-in-Place Concrete Piles to be measured for payment will be in feet of acceptable piles driven, measured to the nearest 1 foot below the cut off elevation.
- D. Furnishing Equipment for Driving Piles.** The work under Furnishing Equipment for Driving Piles will be measured on a lump sum basis.
- E. Dynamic Pile Load Testing.** The quantity of Dynamic Pile Tests to be measured for payment will be the number of pile tests performed. If the pile requires re-driving within 28 hours after the initial test, this shall be considered as one Dynamic Pile Test. If re-driving is more than 28 hours after the initial test, this shall be considered as an additional test.
- F. Static Pile Compressive Load Test (if Required).** This work will be measured as the number of compressive load tests satisfactorily performed.
- G. Splices.** The quantity of splices to be measured for payment will be the number of splices installed, which meet the requirements of §551-2.01 F *Splices* and §551-3.01 F *Splices*.

#### 551-4.02 Micropiles.

- A. Micropiles (Contractor Designed).** This work will be measured as the number of acceptable micropiles installed.
- B. Micropiles (Design Provided).** This work will be measured as the number of feet, measured to the nearest foot, of micropiles satisfactorily installed.
- C. Furnishing Equipment for Installing Micropiles.** This work will be measured on a lump sum basis. No field measurements will be taken.
- D. Permanent Casing for Micropiles (if Required).** This work will be measured as the number of feet, measured to the nearest foot, of permanent casing for micropiles satisfactorily installed below cut off elevation as indicated in the contract documents.
- E. Static Pile Compressive Load Test (if Required).** This work will be measured as the number of compressive load tests satisfactorily performed.

#### 551-4.03 Drilled Shafts

- A. Drilled Shafts and Drilled Shafts (Low Overhead Clearance).** This work will be measured as the number of feet of drilled shaft furnished, installed, and accepted, measured between the cut-off elevation and the tip elevation shown in the contract documents or as changed, in writing, by the Engineer.
- B. Trial Shafts.** This work will be measured as the number of trial shafts installed and accepted.
- C. Furnishing Equipment for Installing Drilled Shafts.** This work will be measured on a lump sum basis. No field measurements will be taken.
- D. Crosshole Sonic Logging (CSL) of Drilled Shafts (if Required).** This work will be measured as the number of drilled shafts on which CSL testing is performed and found to be free of defects which require repair as deemed by the DCETS in accordance with the specification.



- E. Static Pile Compressive Load Test (if Required).** This work will be measured as the number of compressive load tests satisfactorily performed.

## 551-5 BASIS OF PAYMENT

### 551-5.01 Piles

- A. General.** The unit price bid per foot for piles shall include the cost of removal of any material forced up above the bottom of footing by the driving of piles, backfilling of all cavities left by the extraction of damaged piles or from auger holes or soil deformations necessary to place piles, and furnishing and using pile shoes, followers, augers, or spuds.

No payment will be made for piles rejected in accordance with requirements under §551-3.01 A *General*.

- B. Steel H-Piles.** The unit price bid per foot for steel H-Piles shall include the cost of furnishing all labor, including the manipulation of pile driving equipment, materials, and equipment necessary to satisfactorily complete the work.

- C. Cast-in-Place Concrete Piles.** The unit price bid per foot for cast-in-place concrete piles shall include the cost of furnishing all labor, including the manipulation of pile driving equipment, materials, and equipment necessary to satisfactorily complete the work, including concrete, reinforcement, and steel casings. Progress payments will be made, at the unit price bid, for 60% of the quantity after the casings have been satisfactorily driven. The balance of the quantity will be paid for after completion of the work, including cutting off piles, placing concrete in the pile, and painting of exposed pile and pile casings.

- D. Furnishing Equipment for Driving Piles.** The lump sum price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Progress payments will be made at seventy-five percent (75%) of the lump sum bid when the equipment for driving piles is furnished and driving of satisfactory piles has commenced. The remainder will be paid when pile driving is completed.

- E. Dynamic Pile Load Testing.** The unit price bid shall include the cost of furnishing labor, materials, and equipment necessary to satisfactorily support the performance of Dynamic Pile Load Tests.

- F. Static Pile Compressive Load Test (if Required).** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work

Driven Piles that are tested and fail to meet the acceptance criteria will be rejected. Payment will be made for the Static Pile Compressive Load Test under this pay item and for the installation of the pile under its respective item.

- G. Splices.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

### 551-5.02 Micropiles.

- A. Micropiles (Contractor Designed).** The unit price bid shall include the cost of the design of the micropiles and furnishing all labor and materials necessary to satisfactorily complete the

work. Micropiles that fail to meet the acceptance criteria will be rejected and no payment will be made for these micropiles.

**B. Micropiles (Design Provided).** The unit price bid shall include the cost of furnishing all labor and materials necessary to satisfactorily complete the work. Micropiles that fail to meet the acceptance criteria will be rejected and no payment will be made for these micropiles.

**C. Furnishing Equipment for Installing Micropiles.** The unit price bid for furnishing equipment for installing micropiles shall include the cost of all labor, material, and equipment necessary for transporting, erecting, maintaining, making any ordered equipment replacement, dismantling, and removing all installation equipment.

Payment shall be as follows: Seventy-five percent (75%) of the lump sum amount bid will be paid when the required equipment for installing the micropiles is furnished and at least one micropile for each piece of equipment specified has been installed to the Engineer's satisfaction. The remainder will be paid when the work of installing all micropiles is complete.

**D. Permanent Casing for Micropiles (if Required).** The unit price bid shall include the cost of furnishing all labor and materials necessary to satisfactorily complete the work including the placement of grout in the annular space between the permanent casing and the micropile. Include the cost of furnishing equipment for installing permanent casing for micropiles in the item for Furnishing Equipment for Installing Micropiles.

**E. Static Pile Compressive Load Test (if Required).** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work

Contractor Designed Micropiles that are tested and fail to meet the acceptance criteria will be rejected. No payment will be made for the Static Pile Compressive Load Test or for the test pile.

Design Provided Micropiles that are tested and fail to meet the acceptance criteria will be rejected. However, payment will be made for the Static Pile Compressive Load Test under this pay item and for the installation of the micropile under its respective item.

### 551-5.03 Drilled Shafts.

**A. Drilled Shafts.** The unit price bid for each item shall include the cost of furnishing all labor, material, and any equipment necessary to complete the work not included in the applicable pay item for furnishing equipment for installing drilled shafts. This includes progressing the hole through all soil, rock, and obstructions, placing concrete and reinforcing steel in the drilled shaft, installing temporary, interim and/or permanent casing, and supplying the methods and equipment for drilled shaft inspection.

Quality Assurance, including any load testing and non-destructive testing (i.e. crosshole sonic logging), will be paid for under separate items. There will be no payment for additional quality assurance testing (i.e. coring) that is required to verify or quantify anomalies detected by the initial QA testing.

There will be no extra payment for leaving bound temporary casing, deemed acceptable to the Engineer, in place.

Include the cost for furnishing equipment to install Trial Shafts in the applicable pay item for furnishing equipment for installing drilled shafts.

There will be no separate payment for equipment changes to install trial shafts and production drilled shafts.

**B. Furnishing Equipment for Installing Drilled Shafts.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment, including barges, platforms, and support

vessels, necessary for transporting, erecting, maintaining, making any ordered equipment replacement, dismantling, and removing all installation equipment.

Payment will be made as follows: Seventy-five percent (75%) of the amount bid will be authorized for payment when the equipment for installing drilled shafts is furnished and the installation of drilled shafts has commenced. The remainder will be authorized for payment when the work of installing the drilled shafts is completed.

**C. Crosshole Sonic Logging (CSL) of Drilled Shafts (if Required).** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to perform CSL testing and report the results. The cost of repairing possible defects in the shaft concrete and additional CSL testing to verify the effectiveness of the repairs is at the Contractor's expense.

**D. Static Pile Compressive Load Test (if Required).** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work  
 Drilled shafts that are tested and fail to meet the acceptance criteria will be rejected.  
 However, payment will be made for the Static Pile Compressive Load Test under this pay item and for the installation of the shaft under its respective item.

***Payment will be made under:***

<b>Item No.</b>	<b>Item Description</b>	<b>Pay Unit</b>
551.010042	Steel H-Piles (HP 10x42)	Foot
551.010057	Steel H-Piles (HP 10x57)	Foot
551.012053	Steel H-Piles (HP 12x53)	Foot
551.012063	Steel H-Piles (HP 12x63)	Foot
551.012074	Steel H-Piles (HP 12x74)	Foot
551.012084	Steel H-Piles (HP 12x84)	Foot
551.014073	Steel H-Piles (HP 14x73)	Foot
551.014089	Steel H-Piles (HP 14x89)	Foot
551.014102	Steel H-Piles (HP 14x102)	Foot
551.014117	Steel H-Piles (HP 14x117)	Foot
551.016088	Steel H-Piles (HP 16x88)	Foot
551.016101	Steel H-Piles (HP 16x101)	Foot
551.016121	Steel H-Piles (HP 16x121)	Foot
551.016141	Steel H-Piles (HP 16x141)	Foot
551.016162	Steel H-Piles (HP 16x162)	Foot
551.016183	Steel H-Piles (HP 16x183)	Foot
551.018135	Steel H-Piles (HP 18x135)	Foot
551.018157	Steel H-Piles (HP 18x157)	Foot
551.018181	Steel H-Piles (HP 18x181)	Foot
551.018204	Steel H-Piles (HP 18x204)	Foot
551.11	Cast-In-Place Concrete Piles	Foot
551.12	Splices for Steel H-Piles	Each
551.13	Furnishing Equipment for Driving Piles	Lump Sum
551.14	Dynamic Pile Load Testing	Each
551.15	Splices for CIP Piles	Each
551.30	Micropiles (Contractor Designed)	Each
551.31	Micropiles (Contractor Designed) – With Extended Lengths	Each
551.32055	Micropiles (Design Provided - 5.5 in. Diameter)	Foot
551.32060	Micropiles (Design Provided - 6.0 in. Diameter)	Foot
551.32070	Micropiles (Design Provided - 7.0 in. Diameter)	Foot
551.32080	Micropiles (Design Provided - 8.0 in. Diameter)	Foot

551.320963	Micropiles (Design Provided - 9.625 in. Diameter)	Foot
551.321075	Micropiles (Design Provided - 10.75 in. Diameter)	Foot
551.321275	Micropiles (Design Provided - 12.75 in. Diameter)	Foot
551.321338	Micropiles (Design Provided - 13.375 in. Diameter)	Foot
551.33	Permanent Casing for Micropiles	Foot
551.34	Furnishing Equipment for Installing Micropiles	Lump Sum
551.35	Static Pile Compressive Load Test	Each
551.50020	Drilled Shafts (2.0 ft Diameter)	Foot
551.50025	Drilled Shafts (2.5 ft. Diameter)	Foot
551.50030	Drilled Shafts (3.0 ft. Diameter)	Foot
551.50035	Drilled Shafts (3.5 ft. Diameter)	Foot
551.50040	Drilled Shafts (4.0 ft. Diameter)	Foot
551.50045	Drilled Shafts (4.5 ft. Diameter)	Foot
551.50048	Drilled Shafts (4.8 ft. Diameter)	Foot
551.50050	Drilled Shafts (5.0 ft. Diameter)	Foot
551.50055	Drilled Shafts (5.5 ft. Diameter)	Foot
551.50060	Drilled Shafts (6.0 ft. Diameter)	Foot
551.50065	Drilled Shafts (6.5 ft. Diameter)	Foot
551.50070	Drilled Shafts (7.0 ft. Diameter)	Foot
551.50075	Drilled Shafts (7.5 ft. Diameter)	Foot
551.50080	Drilled Shafts (8.0 ft. Diameter)	Foot
551.51020	Drilled Shafts (Low Overhead Clearance - 2.0 ft. Diameter)	Foot
551.51025	Drilled Shafts (Low Overhead Clearance - 2.5 ft. Diameter)	Foot
551.51030	Drilled Shafts (Low Overhead Clearance - 3.0 ft. Diameter)	Foot
551.51035	Drilled Shafts (Low Overhead Clearance - 3.5 ft. Diameter)	Foot
551.51040	Drilled Shafts (Low Overhead Clearance - 4.0 ft. Diameter)	Foot
551.51045	Drilled Shafts (Low Overhead Clearance - 4.5 ft. Diameter)	Foot
551.51048	Drilled Shafts (Low Overhead Clearance - 4.8 ft. Diameter)	Foot
551.51050	Drilled Shafts (Low Overhead Clearance - 5.0 ft. Diameter)	Foot
551.51055	Drilled Shafts (Low Overhead Clearance - 5.5 ft. Diameter)	Foot
551.51060	Drilled Shafts (Low Overhead Clearance - 6.0 ft. Diameter)	Foot
551.51065	Drilled Shafts (Low Overhead Clearance - 6.5 ft. Diameter)	Foot
551.51070	Drilled Shafts (Low Overhead Clearance - 7.0 ft. Diameter)	Foot
551.51075	Drilled Shafts (Low Overhead Clearance - 7.5 ft. Diameter)	Foot
551.51080	Drilled Shafts (Low Overhead Clearance - 8.0 ft. Diameter)	Foot
551.52	Trial Shafts	Each
551.53	Furnishing Equipment for Installing Drilled Shafts	Lump Sum
551.54	Furnishing Equipment for Installing Drilled Shafts (On Water)	Lump Sum
551.55	Furnishing Equipment for Installing Drilled Shafts (Low Overhead Clearance)	Lump Sum
551.56	Crosshole Sonic Logging (CSL) of Drilled Shafts	Each

## **SECTION 552 - EXTERNALLY STABILIZED CUT STRUCTURES**

(Last Revised May, 2016)

### **552-1 DESCRIPTION**

**552-1.01 Permanent Sheeting.** Under this work, the Contractor shall furnish and install permanent sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer.

All the sheeting and supports will be left in place as a finished structure unless removal of waling and bracing is called for in the contract documents.

**552-1.02 Temporary Sheeting.** Under this work, the Contractor shall furnish, install, maintain and remove temporary sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer. It may be left in place only with the written permission of the Engineer.

**552-1.03 Interim Sheeting.** Under this work, the Contractor shall furnish, install, maintain, cut off and remove sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer.

The interim sheeting shall be cut off and removed only to the elevation shown in the contract documents. The remaining material shall be left in place.

**552-1.04 Shields and Shoring.** Under this work, the Contractor shall design, furnish, place, maintain and remove a shields and shoring system at locations shown in the contract documents or as directed by the Engineer. Details of the shields and shoring system must conform to the requirements of 29 CFR 1926. It may be left in place only with the written permission of the Engineer.

**A. Shields and Shoring (S&S) System.** An S&S system is a pre-engineered, protective/support system used in trenches to provide direct support of the trench sidewalls in addition to protecting workers within the trench. An S&S system may consist of sheeting, shoring, shield systems, trench box, trench shield or other pre-engineered protective systems.

**552-1.05 Soldier Pile and Lagging Wall.** Under this work, the Contractor shall furnish and place a soldier pile and lagging wall in accordance with the contract documents; cut off walls located within the roadway limits to the elevation shown in the contract documents and leave the remainder in place unless removal is granted, in writing, by the Engineer; completely remove walls outside the roadway limits if noted on the plans; and dispose of removed material.

**552-1.06 Alternate Design.** The Contractor may submit to the Department a construction alternate other than that presented in the contract documents as a Value Engineering Change Proposal. A simple material substitution involving a sheeting section modulus or soldier pile designation greater than that shown in the contract documents will be considered for acceptance. All proposed changes to details shown in the contract documents must be approved, in writing, by the Deputy Chief Engineer for Technical Services.

Any geotechnical analysis for a flexible support system shall be done in accordance with the procedures contained in the geotechnical design procedure "*Geotechnical Design Procedure for Flexible Wall Systems*".

## **552-2 MATERIALS**

### **552-2.01 Permanent Sheeting**

**A. Permanent Timber Sheeting.** Permanent timber sheeting shall be new and unused and consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 *Stress Graded Timber and Lumber*. Timber sheeting shall be treated in accordance with §708-31 *Wood Preservative - Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B. The timbers shall meet or exceed the actual cross section or stress grade shown in the contract documents. The timbers shall be sound and free from any defects which might impair its strength or tightness. The materials shall include all necessary waling and bracing required.

**B. Permanent Steel Sheeting.** Steel sheeting shall be new and unused conforming to the provisions of §715-17 *Steel Sheeting*. Waling and bracing shall be new and unused conforming to the provisions of §715-01 *Structural Steel*. Stock steel may be used.

#### **552-2.02 Temporary Sheeting**

**A. Temporary Timber Sheeting.** Temporary timber sheeting shall consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 *Stress Graded Timber and Lumber*.

Temporary timber sheeting shall consist of new or used, treated or untreated material in satisfactory condition and suitable for the intended use. The Engineer will reject unsatisfactory materials.

**B. Temporary Steel Sheeting.** The steel sheeting, waling and bracing shall consist of new or used material in satisfactory condition and suitable for the intended use. The materials shall include all necessary waling and bracing required. The Engineer will reject unsatisfactory materials.

#### **552-2.03 Interim Sheeting**

**A. Interim Timber Sheeting.** Interim timber sheeting shall consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 *Stress Graded Timber and Lumber*.

Interim timber sheeting shall consist of new or used, treated or untreated material but shall be in satisfactory condition and suitable for the intended use. The Engineer will reject unsatisfactory materials.

**B. Interim Steel Sheeting.** Steel sheeting and any steel waling and bracing to remain in place shall be new and unused conforming to the provisions of §715-17 *Steel Sheeting*. Steel sheeting, steel waling and bracing which is removed after use shall consist of new or used material in satisfactory condition and suitable for the intended use. The materials shall include all necessary waling and bracing required. The Engineer will reject unsatisfactory materials.

**552-2.04 Shields and Shoring.** The selection of S&S systems and materials shall be the Contractor's option. The Engineer will reject unsatisfactory materials.

#### **552-2.05 Soldier Pile and Lagging Wall.**

**A. Soldier Pile.** Soldier piles shall be as shown on the contract documents and conform to the requirements of §715-18 *Soldier Piles*. Waling and bracing shall be as shown in the contract documents and conform to the requirements of §715-01 *Structural Steel*. No pile splices will be allowed unless approved, in writing, by the Deputy Chief Engineer for Technical Services.

Used material is permitted for temporary walls unless otherwise noted on the plans, provided the material is in conformance with the specification and is acceptable for use.

**B. Lagging.** Lagging type(s) shall be as shown in the contract documents:

**1. Treated Wood.** Treated wood shall meet or exceed the full dimension thickness shown in the contract documents and graded for an extreme fiber stress of at least 1000 psi conforming to the material requirements of §712-14 *Stress Graded Timber and Lumber*. Timbers shall be treated in accordance with §708-31 *Wood Preservative - Waterborne*. The treatment shall be applied in

conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

**2. *Untreated Wood.*** Untreated wood shall be graded for an extreme fiber stress of at least 1000 psi conforming to the provisions of §712-14 *Stress Graded Timber and Lumber* and shall meet or exceed the full dimension thickness shown in the contract documents.

**3. *Precast Concrete Panels.*** Precast concrete panels shall conform to the provisions of §704-24 *Precast Concrete Panels*.

**4. *Steel Sheeting.*** Steel sheeting shall conform to the provisions of §552-2.01 B. *Permanent Steel Sheeting*.

**C. *Backfill for Holes.*** Backfill material shall be as shown in the contract documents:

**1. *Concrete Backfill.*** Concrete backfill shall be Class G concrete conforming to the provisions of Section 555 *Structural Concrete*.

**2. *Grout Backfill.*** Grout backfill shall be a workable mixture capable of stabilizing the hole being excavated. The Contractor shall use either:

**i. *Controlled Low Strength Material.*** Material meeting the requirements for Controlled Low Strength Material as stated in §733-01 *Flowable Fill*.

**ii. *Controlled Low Strength Material (No Fly Ash).*** Material meeting the requirements for Controlled Low Strength Material (No Fly Ash) as stated in §733-01 *Flowable Fill*.

**iii. *Grout.*** Cement, concrete sand and water conforming to Table 552-1 *Grout Backfill Requirements*.

TABLE 552-1 GROUT BACKFILL REQUIREMENTS	
Material	Subsection
Portland Cement Type 2	§701-01
Concrete Sand	§703-07
Water	§712-01

### 552-3 CONSTRUCTION DETAILS

**552-3.01 General.** The Contractor shall install sheeting having a section modulus not less than that shown in the contract documents. The Contractor shall install soldier piles meeting the size designation shown in the contract documents.

Any material which stops the driving of sheeting or soldier piles within a depth of 10 feet from the ground surface at the time of driving shall be removed by the Contractor. Payment for removal of such material and any backfill required to fill the resulting void will be made under the appropriate pay items. If very compact material or boulders prevent the progression of the sheeting or soldier piles to the design tip elevation at a greater depth, the Contractor shall notify the Engineer.

The Contractor shall perform work in a manner that causes no subsidence of the surrounding ground surface. If subsidence should occur, the Contractor shall cease work and provide a written plan to prevent subsidence for approval by the Engineer. The Contractor shall repair all damage that resulted from the subsidence at no additional cost to the State.

**552-3.02 Temporary Sheeting.** The Contractor shall install temporary sheeting having a section modulus which meets or exceed that shown in the contract documents.

After its function is no longer required, the Contractor shall remove the sheeting placed under this work, or with the written permission of the Engineer, leave it in place after cutting off the tops at an agreed elevation.

**552-3.03 Interim Sheeting.** The Contractor shall install interim sheeting having a section modulus which meets or exceed that shown in the contract documents.

The Contractor shall cut off the interim sheeting and remove it to the elevation shown in the contract documents. The remaining material shall be left in place.

**552-3.04 Shields and Shoring.** The Contractor shall install a S&S system in accordance with the contract documents.

The S&S installed under this work shall be of sufficient size and strength to meet the requirements of 29 CFR 1926 and the Live Load requirement as contained in the AASHTO Standard Specifications for Highway Bridges. Prior to use, the Contractor shall supply the Engineer with documentation of compliance. The S&S may be left in place only with the written permission of the Engineer.

All damage to the adjacent pavement or ground caused by the use of the chosen S&S (e.g. voids beneath the pavement or shoulder, pavement or shoulder cracking or subsidence, ground settlement) shall be repaired at no additional cost to the State. Severe damage which directly affects the safety of the public shall be immediately repaired. The operation shall be halted until a satisfactory prevention method is instituted.

**552-3.05 Soldier Pile and Lagging Wall.** The Contractor shall install Soldier Piles meeting the size designation shown in the contract documents either by driving or by placing them in holes as indicated on the plans in accordance with Table 552-2 *Soldier Pile and Lagging Wall Pile Tolerances*. For each pile out of tolerance, provide a satisfactory replacement or provide a modification approved by the Engineer prior to proceeding. No pile splices will be allowed unless approved, in writing, by the Deputy Chief Engineer of the Office of Technical Services.

<b>TABLE 552-2 SOLDIER PILE AND LAGGING WALL PILE TOLERANCES</b>	
<b>Survey Location</b>	<b>Tolerance</b>
Plan	3 inches at the top of pile.
Vertical	Vertical tolerance of 1/8 inch per foot on each axis of the soldier pile shown on the plans. Verify the axis on the top 5 feet of the soldier pile with a straight edge (5 feet minimum length) and a level (4 feet minimum length).

**A. Driving Piles.** Soldier piles shall be equipped with shoes in conformance with provisions of §551-3.02 *Steel H-Piles*, and driven in conformance with provisions of §551-3.04 *Furnishing Equipment for Driving Piles*, except that submission of Form BD 138 is not required and the use of a vibratory hammer is an acceptable means of pile driving.

**B. Creating Holes for Pile Installation.** The Contractor shall provide equipment capable of establishing and maintaining holes of the minimum diameter and to the depth or elevation shown in the contract documents. Temporary sleeves or casings are permitted and may be required as per the plans. Jetting is not permitted.



If the top of socket elevation shown in the contract documents varies by more than 2 feet, the Contractor shall stop work and notify the Engineer. The Engineer will notify the Geotechnical Engineering Bureau and obtain written recommendations prior to allowing the work to proceed.

Upon completion of the hole, the Contractor shall install the soldier pile in accordance with Table 552-2 *Soldier Pile and Lagging Wall Pile Tolerances*.

**C. Backfilling.** After placing the piles, the Contractor shall backfill holes with the backfill(s) indicated in the contract documents.

**1. Concrete Backfill.** The Contractor shall place backfill in accordance with the provisions of §555-3.04 *Handling and Placing Concrete* and §555-3.05 *Depositing Structural Concrete Under Water* as shown in the contract documents. The Contractor shall allow a minimum curing time of one day before placing any lagging.

**2. Grout Backfill.** The Contractor shall place backfill in accordance with the provisions of §555-3.04 *Handling and Placing Concrete* and §555-3.05 *Depositing Structural Concrete Under Water*. The Contractor shall allow a minimum curing time of one day before placing any lagging.

**D. Lagging.** The Contractor shall install horizontal lagging so that the unsupported soil height does not exceed 3 feet at any time. If the method chosen for attaching the lagging to the soldier piles requires reattachment of lagging to the soldier piles due to planned excavation on both sides of the wall, the Contractor shall reattach the lagging at no additional cost to the State.

The Contractor shall fabricate the precast concrete lagging to the shape and size shown in the contract documents.

**E. Wall Removal.** The Contractor shall cut off soldier piles placed within the roadway limits at the subgrade surface unless otherwise noted in the contract documents. Soldier piles placed outside the roadway limits may be removed or cut off a minimum of 2 feet below final ground surface unless otherwise noted in the contract documents.

If lagging is to be removed, the Contractor shall remove the lagging so that the unsupported soil height does not exceed a maximum of 3 feet at any time. This maximum height may be reduced, based on specific site conditions, in order to prevent collapse and loss of ground.

## 552-4 METHOD OF MEASUREMENT

**552-4.01 General.** When a support system is used in stage construction, the quantity of support system will be the maximum number of square feet satisfactorily installed between the payment lines shown in the Contract Documents measured on only one side of adjacent construction stages.

**552-4.02 Permanent Sheeting.** The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be at the intersection of the sheeting and the ground surface at the time of commencing work or at the completion of backfilling operations, whichever is higher. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.

**552-4.03 Temporary Sheeting.** The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be the original ground at the time of commencing work. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.

**552-4.04 Interim Sheeting.** The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be the original ground at the time of commencing work. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.

**552-4.05 Shields and Shoring.** The quantity of shields and shoring will be in square feet, measured to the nearest square foot, obtained by multiplying the vertical length between the payment lines herein described, measured on both sides of the excavation, by the horizontal length of S&S actually used. The upper payment line will be the ground surface existing at the site prior to the beginning of the work. The lower payment line will be the bottom of the excavation immediately adjacent to the protection system. The horizontal length will be the length of protection system installed measured along the payment lines as shown in the contract documents. Both sides of the excavation will be measured and computed for payment.

#### **552-4.06 Soldier Pile and Lagging Wall.**

**A. Holes in Earth.** The quantity to be measured for payment will be in feet of holes in earth installed. The upper payment limit is the intersected grade or ground line whichever is lower. For holes requiring rock sockets, the lower payment limit is the top of rock. For holes without rock sockets, the lower payment limit is the pile tip elevation.

**B. Rock Sockets.** The quantity to be measured for payment will be in feet of sockets in rock installed. The upper payment limit is the top of rock as shown on the plans. The lower payment limit is the pile tip elevation.

**C. Soldier Piles.** The quantity to be measured for payment will be in feet of soldier piles installed. The upper payment limit is the pile top elevation. The lower payment limit is the pile tip elevation.

**D. Lagging.** The quantity of lagging to measure for payment will be the number of square feet, to the nearest square foot, between the payment lines shown in the contract documents.

#### **552-5 BASIS OF PAYMENT**

**552-5.01 Permanent Sheeting.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment, waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item.

**552-5.02 Temporary Sheeting.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment, waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item. Progress payments in the amount of 75% of the bid amount will be made upon installation of the sheeting with the remainder paid upon its satisfactory removal. If the Contractor leaves all or part of the sheeting in place, it will be at no additional cost to the State and the remaining 25% of the bid amount will be paid after its function is no longer required.

**552-5.03 Interim Sheeting.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment,

waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item. Progress payments in the amount of 75% of the bid amount will be made upon installation of the sheeting with the remainder paid upon satisfactory removal of that portion specified in the contract documents. If the support system is to be left in place in its entirety, the remainder will be paid after its function is no longer required. The cost of any work necessary to cut off and remove the specified portion shall be included in the unit price bid.

**552-5.05 Shields and Shoring.** The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including equipment, waling, bracing, and design services when employed.

If the Engineer directs, in writing, that the S&S be left in place, this will be classified as extra work.

**552-5.05 Soldier Pile and Lagging Wall.**

**A. Holes in Earth.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including progressing the hole through obstructions.

**B. Rock Sockets.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

**C. Soldier Piles.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including pile driving equipment, pile shoes, backfilling the hole and cutting off the soldier pile where required. No additional payment will be made for complete pile removal, where allowed. Splices approved, in writing, by the Deputy Chief Engineer for Technical Services will be paid for under the appropriate pay item.

**D. Lagging.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including waling, bracing, connections and lagging removal, where required. No additional payment will be made when a wall is excavated on both sides. No additional payment will be made if wood lagging is placed behind concrete.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
552.10	Permanent Timber Sheeting	Square Foot
552.11	Permanent Steel Sheeting	Square Foot
552.12	Temporary Timber Sheeting	Square Foot
552.13	Temporary Steel Sheeting	Square Foot
552.14	Interim Timber Sheeting	Square Foot
552.15	Interim Steel Sheeting	Square Foot
552.17	Shields and Shoring	Square Foot
552.20nn	Holes in Earth for Soldier Pile and Lagging Wall	Foot
552.21nn	Rock Sockets for Soldier Pile and Lagging Wall	Foot
552.22nn	Soldier Piles for Soldier Pile and Lagging Wall	Foot
552.2301nn	Treated Wood Lagging for Soldier Pile and Lagging Wall	Square Foot
552.2302nn	Untreated Wood Lagging for Soldier Pile and Lagging Wall	Square Foot
552.2303nn	Precast Concrete Panel Lagging for Soldier Pile and Lagging Wall	Square Foot
552.2304nn	Steel Sheeting Lagging for Soldier Pile and Lagging Wall	Square Foot

Note: nn denotes serialized pay item. Each wall and its associated components will be serialized.

## SECTION 553 - COFFERDAMS AND WATERWAY DIVERSION STRUCTURES (Last Revised January, 2021)

### 553-1 DESCRIPTION

**553-1.01 Cofferdams.** This work shall consist of the design, placement, maintenance, and removal of cofferdams as shown in the contract documents. The Contractor shall also construct, maintain, stabilize, backfill, and restore adequate sediment removal area(s) for water discharge control at location(s) shown on the contract documents or where allowed by the Engineer. For design purposes, the bottom of excavation elevation shall be assumed to be the deepest excavation of the entire area enclosed by the cofferdam.

A waterway diversion structure is not a substitution for, or equal to, a cofferdam.

**A. Cofferdams (Type 1).** Cofferdams (Type 1) shall apply for a water depth exceeding 8'-0", measured from the bottom of excavation to the Ordinary High Water Elevation, as shown in the contract plans or when special conditions warrant.

**B. Cofferdams (Type 2).** Cofferdams (Type 2) shall apply to a maximum anticipated depth of 8'-0", measured from the bottom of excavation to the Ordinary High Water Elevation, as shown in the contract plans.

**553-1.02 Temporary Waterway Diversion Structures.** This work shall consist of the design, installation, maintenance, and removal of a temporary Waterway Diversion structure as shown in the contract documents.

**553-2 MATERIALS.** The materials shall be timber or steel sheeting in accordance with the requirements of §552-2.02 *Temporary Sheeting*, tightly sealed impermeable gravel filled bags, precast concrete, a commercially designed system manufactured specifically for the control of water, or other material. Gravel filled bags shall be in accordance with §209-2.04 *B. Gravel Bag Check Dams*. Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 *Geotextile* with a strength class 1 or 2 and shall include ties. No burlap bags shall be allowed. Fill material shall meet the requirements of §703-02 *Coarse Aggregate*, size designation #1 or #2 as described in Table 703-4. Gravel filled bags shall not have an open top.

### 553-3 CONSTRUCTION DETAILS

**553-3.01 Cofferdams.** The Contractor shall construct cofferdams to keep an excavation free from earth, water, ice, or snow, and to permit excavation to the elevation indicated in the contract documents. Cofferdams shall be designed and constructed to allow flooding at the designed water level, by non-mechanical means such as overtopping or flooding ports. Cofferdams, when used in conjunction with a tremie pour, shall be designed and constructed to automatically flood at the elevation indicated by note in the plans.

If permanent or temporary sheeting is required by the contract documents at the location of the cofferdam, the Contractor may elect to incorporate this material into the cofferdam system. Bracing may be required to satisfactorily perform excavation, dewatering, and other required construction operations. Permanent sheeting shall be returned to its intended condition after all cofferdam equipment and material, including any additional bracing, have been removed.

Cofferdams shall be maintained in a dewatered condition during foundation construction. The placement of foundation concrete shall not be impeded by water standing or flowing within the cofferdam.

Dewatering equipment and bracing shall be of adequate capacity and shall be so arranged as to permit their proper functioning. Dewatering equipment and bracing shall be so located to permit construction of the structure in accordance with the contract documents.

All damage caused by the failure of a cofferdam to perform its proper function shall be the responsibility of the Contractor. The Contractor shall submit proposed repair methods a minimum of 10 work days prior to beginning any remedial activities. The contractor is responsible for obtaining any required environmental permits/authorizations and shall not commence repair work prior to receipt.

The Contractor shall not erect the cofferdam beyond the limits shown on the contract documents unless approved by the Engineer and DCES. If approved, the Contractor shall be responsible for obtaining all required environmental permits or modifications to existing environmental permits and shall not proceed until all required permits have been obtained.

The Contractor shall place the cofferdam so that it will not interfere with any battered piles.

Turbid water from dewatering operations shall not be discharged to a stream or wetland and shall be directed to a settling basin, upland vegetated area, or other sediment-removal method approved by the Engineer, sufficient to ensure that water returned to the waterbody or wetland from the coffered work area, sediment basin, or temporary water control structure is as clear as the receiving waterbody. Discharge of water from dewatering operations shall not cause or exacerbate erosion.

The Contractor shall provide for safe ingress and egress from the cofferdam.

**553-3.02 Temporary Waterway Diversion Structures.** Waterway diversion structures shall be constructed at the location(s) as shown on the contract documents to divert the flow of water. The structure shall be continuous and constructed in accordance with any regulatory agency permit conditions.

If a system commercially designed and manufactured specifically for the control of water is used, it shall be installed and maintained in accordance with the manufacturer's recommendations.

When Waterway Diversion with bypass pumping is used, the Contractor's plan shall address the following:

- At a minimum, pump(s) shall be sized for the flow expected during Ordinary High Water.
- Intake sump shall be installed in a manner that does not erode, or otherwise degrade the channel.
- Isolation of the work area from stream flow shall be constructed of clean man-made materials, as per 553-2 MATERIALS. No material shall be used that would create a water quality violation or affect the integrity of the waterway, such as by pushing/excavating streambed material or soil into a berm to use for isolation of the work area.
- Excavated material may not be used to create a temporary berm unless specifically allowed in the contract documents.
- Diverted water shall be pumped directly back to the stream below the project. Water flows shall be maintained so that flow immediately downstream of the work area is equal to water flow immediately upstream of the work area and there is no visible contrast between water upstream of the work site or addition of pollutants from the work site. Bypass flow sufficient to maintain aquatic life downstream shall be maintained.
- Water returned to the waterway at the diversion outlet shall be discharged in a manner that does not cause or contribute to erosion.
- An action plan for removing the diversion in the event of high flow conditions shall be provided.

All damage caused by the failure of the temporary Waterway Diversion structure to perform its proper function shall be repaired by the Contractor at no cost to the State.

### **553-3.03 Submittals.**

**A. Cofferdams.** Cofferdams and cofferdam removal shall be designed by the Contractor's Professional Engineer in accordance with §107-12 *Water Quality Protection* and §209 *Soil Erosion and Sediment Control*, and all applicable regulations and permit conditions. (See §101-02) All

systems submitted shall be designed for the static water pressure plus stream pressure and ice pressures as appropriate, based on the type of cofferdam defined in 553-1.01. The design of cofferdams shall conform to the AASHTO LRFD Bridge Design Specifications, AASHTO Standard Specifications for Highway Bridges, or other industry accepted design codes. The cofferdam shall be designed, at a minimum, for the Ordinary High Water Elevation, as shown in the contract plans. The Contractor shall indicate the water elevation above which the system will be flooded to avoid overloading.

**1. Cofferdam (Type 1).** The Contractor shall submit the design, including computations and method of installation, to the Engineer for approval by the Deputy Chief Engineer Structures (DCES) a minimum of 20 work days prior to starting the work. The Contractor shall not begin construction of any cofferdam prior to DCES approval.

**2. Cofferdam (Type 2).** The Contractor shall submit the methods to be employed to the Engineer for review and approval a minimum of 10 work days prior to starting the work.

**B. Temporary Waterway Diversion Structure.** The Contractor shall design Waterway Diversion Structures in compliance with requirements of all regulatory agency permits or approvals and submit the methods to be employed to the Engineer for review and approval a minimum of 10 work days prior to beginning construction/installation of any temporary waterway diversion structure. Construction shall not be started prior to receipt of approval.

**553-3.04 Removal.** The Contractor shall remove the temporary portion of the cofferdam installation or the waterway diversion structure, including anchor spuds if used, after such time that it is no longer necessary. The removal shall be sequenced to minimize turbidity and prevent the discharge of materials into the waterway. The cofferdam removal shall be in accordance with §107-12 *Water Quality Protection* and §209 *Soil Erosion and Sediment Control*, and all applicable regulations and permit conditions.

#### **553-4 METHOD OF MEASUREMENT**

**553-4.01 Cofferdams.** The quantity to be measured for payment will be the number of cofferdams installed.

**553-4.02 Temporary Waterway Diversion Structures.** The quantity to be measured for payment will be the number of temporary waterway diversion structures installed.

#### **553-5 BASIS OF PAYMENT**

**553-5.01 Cofferdams.** The unit price bid for each cofferdam shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including the sediment removal methods. No separate payment will be made for any additional temporary erosion control measures required to facilitate removal.

When a cofferdam is installed incorporating permanent or temporary sheeting required by the plans, payment will be made for each cofferdam established, including any miscellaneous sheeting, additional bracing, anchor spudding, or other material necessary to complete the work. The permanent or temporary sheeting, if used as part of the cofferdam, will be paid for under a separate item.

Progress payments will be made at 75% of the bid price after cofferdam installation, construction of the sediment removal area(s) and initial dewatering. The remaining 25% will be paid upon satisfactory removal of the cofferdam and restoration of the sediment removal areas.

**553-5.02 Temporary Waterway Diversion Structures.** The unit price bid for each temporary waterway diversion structure shall include the cost of furnishing all labor, equipment, and materials necessary to satisfactorily complete the work.

If the Contractor is required to extend the temporary waterway diversion structure beyond the limits shown in the contract documents, changes to the diversion structure will be considered extra work.

Progress payments will be made at 75% of the bid price when the waterway diversion structure is satisfactorily installed. The remaining 25% will be paid when all temporary equipment and materials have been removed, and the waterway and impacted areas have been satisfactorily restored.

*Payment will be made under:*

<b>Item No.</b>	<b>Item Pay Unit</b>	
553.01nnnn	Cofferdam (Type 1)	Each
553.02nnnn	Cofferdam (Type 2)	Each
553.03nnnn	Temporary Waterway Diversion Structure	Each

**Note:** nnnn denotes serialized pay item.

## **SECTION 554 - FILL TYPE RETAINING WALLS**

(Last Revised May, 2020)

**554-1 DESCRIPTION.** This work shall consist of furnishing and installing a fill type retaining wall at the location(s) and to the elevation(s) shown in the contract documents.

**554-1.01. General.** The fill type classification refers to the construction method used for the installation of the wall. Fill type retaining walls are retaining structures constructed from the base of the wall to the top (i.e. “bottom-up” construction).

The fill type retaining walls are further classified according to the basic mechanism of lateral load support. These classifications include internally stabilized fill structures and externally stabilized fill structures.

The specification is supplemented with an Approved List which provides a listing of available designers and their corresponding fill type retaining walls. Fill type retaining walls are further defined in the pertinent subsequent section. For proprietary fill type retaining wall systems, approved designers, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Designers wishing to have their wall systems reviewed for placement on the Approved List shall follow the procedural directives of the Geotechnical Engineering Bureau as contained in Highway Design Manual Appendix 9A.

**554-1.02 Definitions.** Internally stabilized fill structures are structures which rely on friction developed between closely-spaced reinforcing elements and the backfill to resist lateral soil pressure and are subcategorized in the retaining wall subsections of this specification. Externally stabilized fill structures are structures which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.

**A. Wall System.** A wall system is either a series of open top face units assembled to form bins which are connected in unbroken sequence or a combination of specific solid face units with a characteristic alignment and connection method, which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure. As indicated, the bin volume is infilled with backfill material to supplement the face unit geometry, adding to the stability of the system.

**B. Internally Stabilized Wall System.** A wall system which, when constructed beyond wall heights exceeding the maximum allowable unreinforced height per the Approved List, relies on reinforcing elements within the backfill to provide stability.

**C. Internally Stabilized Earth System.** A series of tensile reinforcing elements which, when placed in multiple layers within the backfill volume, improves the strength such that the vertical face of the stabilized earth volume is essentially self supporting.

**D. Internally Stabilized Fill Structures.**

**1. Fill Structure.** A fill type retaining wall as described in §554-1.01 *Fill Type Retaining Walls* which consists of either an internally stabilized wall system or an internally stabilized earth system.

**i. Mechanically Stabilized Earth System (MSES).** An MSES is an internally stabilized fill structure comprised of an unreinforced concrete leveling pad, precast concrete face panel units and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSES designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, leveling pad, and subsurface drainage system, are obtained from the approved wall system designer.

**ii. Mechanically Stabilized Wall System (MSWS).** An MSWS is an internally stabilized fill structure comprised of an unreinforced concrete or compacted granular fill leveling pad, face units (solid or open top) and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSWS designers with face units appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, face unit infill, leveling pad material, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

**iii. Geosynthetically Reinforced Soil System (GRSS).** A GRSS is an internally stabilized fill structure comprised of earth backfill, geosynthetic reinforcing elements used for internal stabilization and surface protection to resist erosion.

**a. GRSS Wall.** For wall applications, the surface protection is the permanent facing elements (excluding precast units) or a geotextile face wrap which typically includes welded wire forms remaining from the installation operation.

**b. GRSS Slope.** For slope applications, the surface protection consists of a secondary reinforcing element to aid in stability of the slope face between primary reinforcing layers. To protect against erosion, the GRSS slope is covered by either a non-degradable erosion control mat or a granular fill slope protection blanket.

Although GRSS is a fill type retaining wall, it is not a part of the selection process outlined in §554-3.01A. *Fill Type Retaining Wall Selection* or supplemented by the Approved List for Fill Type Retaining Walls, as it is not a proprietary system. A GRSS will be designed and detailed in the contract documents by the Department or its representatives.

**2. Leveling Pad.** A compact surface which serves as a flat, level area for placing the initial course of face units.

**i. Concrete.** An unreinforced concrete slab.



*ii. Granular.* A compacted granular fill pad.

**3. Face Unit.** A structural unit incorporating a means for attaching the backfill reinforcing element, which restrains the alignment of the wall system during installation compaction operations and provides support for the front edge of the backfill for the life of the wall system.

*i. Panel Unit.* A precast concrete panel incorporating a means for attaching the backfill reinforcing element, forming part of the face area of the MSES.

*ii. Solid Unit.* A face unit which has a solid mass and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

*iii. Open Top Unit.* A face unit which has an open structure, to allow placement of infill material, and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

*iv. Corner Unit.* A corner unit is a face unit having two faces.

*v. Geotextile Face Wrap.* A layer of geotextile used to prevent loss of backfill, typically employed in a temporary wall application in conjunction with welded wire forms. In applications where a geotextile is used as the primary reinforcing element, it may be designed to also function as the face wrap.

*a. Welded Wire Forms.* A non-structural system used in temporary walls to aid in compaction near the face of the wall.

*vi. Geocells.* A three-dimensional, permeable polymeric honeycomb or web structure expandable panels used to confine fill materials to create structural stability.

*vii. Timbers.* A dressed piece of wood used as a building material.

*viii. Gabions.* A partitioned, wire fabric container filled with stone to form a flexible and permeable structure.

**4. Alignment and Connection Device.** Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain positive location for a face unit and also provide a means for connecting the reinforcing elements.

**5. Fastener.** Hardware used to connect the reinforcing element to the attaching device.

**6. Coping.** A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

**7. Joint Filler.** Material used to fill the joints between face units.

**8. Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

**9. Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

**10. Reinforcing Element.** An inclusion connected to the face unit and extending into the backfill for the purpose of backfill stabilization.

**i. Inextensible Reinforcement.** A metal strip typically incorporating ribs on the top and bottom, or metal grids with design specific mesh openings.

**ii. Extensible Reinforcement.** Geogrid or geotextile sheets typically made from high density polyethylene/ polypropylene geogrids or high tenacity polyester geogrids, or high strength geotextiles.

**11. Unit Infill.** Granular material placed within the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

**12. Backfill.** Granular material placed and compacted in conjunction with the reinforcing elements and face units.

**13. Geomembrane.** An impermeable geosynthetic composed of one or more synthetic sheets used to isolate the backfill material from surface water and deicing salt infiltration as a means to prevent corrosion of the reinforcing elements.

**14. Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.

**15. Identification Markers.** Signs and marking tape, buried near the finished grade, to identify and prohibit excavation of the reinforced backfill.

#### **E. Externally Stabilized Fill Structures.**

**1. Fill Structure.** A fill type retaining wall as described in §554-1.01 *Fill Type Retaining Walls* which consists of a prefabricated face unit.

**i. Prefabricated Wall System (PWS).** A PWS is an externally stabilized fill structure comprised of prefabricated face units & coping units, including leveling pads, unit infill, earth backfill, joint filler material and geotextile, and a subsurface drainage system to reduce hydrostatic pressure on the wall system. Only PWS designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, unit infill, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

When reinforcement is introduced to a PWS, they shall be reclassified as Mechanically Stabilized Wall Systems and the pertinent sections of the specification shall apply.

**2. Leveling Pad.** A compact surface which serves as a flat, level area for placing the initial course of face units.

**i. Concrete.** An unreinforced concrete slab.

**ii. Granular.** A compacted granular fill pad.

**3. Face Unit.** A prefabricated concrete element, incorporating alignment and connection devices, that is able to be arranged, stacked, placed, combined, or interchanged easily into an assembled wall system.

*i. Solid Unit.* A face unit which has a solid mass, utilizing the weight of the wall system elements to resist lateral soil pressure. A solid unit may require some infill material depending on the geometric bevel of the units.

*ii. Open Top Unit.* A face unit which has an open structure to allow placement of infill material, utilizing the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.

**4. Bin.** Any volumetric space which is designated to be infilled, as defined in this section, and is encompassed within the dimensions of the open top unit.

**5. Alignment and Connection Device.** Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain a positive location.

**6. Coping.** A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

**7. Joint Filler.** Material used to fill the joints between face units.

**8. Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

**9. Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

**10. Unit Infill.** Granular material placed within the bin, such as the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

**11. Backfill.** Granular material placed directly behind and/or above the bins in conjunction with the wall assembly.

**12. Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.

**F. Aesthetic Treatment.** A treatment applied to the face either during or after the manufacture of the face units to modify the appearance of the units and of the wall as a whole. Aesthetic treatment can include modifications to color, texture, architectural pattern, the addition of exposed surface aggregate (real or artificial), the addition of simulated joints or cracks, or any other treatment or material that modifies the appearance, provided that the structural integrity, function, or life span of the wall is not negatively impacted.

## 554-2 MATERIALS.

**554-2.01. Fill Type Retaining Walls.** Provide materials for the selected fill type retaining wall as outlined in the pertinent subsequent section.

**554-2.02. Mechanically Stabilized Earth System.** Not all materials listed below are required for each MSES. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. MSES Leveling Pad.** Provide leveling pad material meeting the requirements of Section 501 *Portland Cement Concrete - General*, Class A concrete.

**1. Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 *Cushion Sand*, in lieu of MSES backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

**B. MSES Facing Panel Units.** Fabricate precast concrete face panel units and incidental precast units in accordance with the requirements of §704-14 *Precast Concrete Panel Units*. The default aesthetic treatment for an MSES facing panel is a plain, smooth concrete finish of natural concrete (gray) color.

**1. Coping Unit.** Fabricate precast concrete coping units, and incidental precast units in accordance with the requirements of §704-14 *Precast Concrete Panel Units*.

**C. MSES Fasteners and Attaching Devices.** The fasteners and attaching devices are specific to each wall system and provided by the wall system manufacturer. The fasteners and attaching devices associated with each approved wall system appear on the Approved List under wall system components.

**D. MSES Joint Fillers.** Fill joints with material approved by DCES and approved by the wall system designer.

**E. MSES Geotextile.** Provide a geotextile meeting the requirements of §737-01B *Geotextile Separation*.

**F. MSES Slip Joints.** The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

**G. MSES Metal Reinforcing Strips.** Provide reinforcing strips of ASTM Designated metal grades and galvanize in accordance with the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*. The reinforcing strips associated with each approved wall system appear on the Department's Approved List under wall system components.

**H. MSES Metal Reinforcing Mesh.** Fabricate the reinforcing mesh from cold drawn steel wire conforming to the requirements of §709-09 *Cold Drawn Wire for Concrete Reinforcement*, and weld into the finished mesh fabric in accordance with the requirements of §709-02 *Wire Fabric for Concrete Reinforcement*. Galvanize in accordance with §719-01 *Galvanized Coatings and Repair Methods, Type I*. The reinforcing mesh associated with each approved wall system appears on the Department's Approved List under wall system components.

**I. MSES Geogrid Reinforcing Element.** Provide geogrid reinforcing elements meeting the requirements of §737-07 *Geogrids*. The grid(s) associated with each approved wall system appear on the Approved List under wall system components.

**J. MSES Backfill.** Provide backfill material meeting the requirements of §733-02 *Mechanically Stabilized Earth System Backfill Material*.

**1. MSES Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

**K. MSES Geomembrane.** Provide a geomembrane meeting the requirements of §737-02 *Geomembranes*.

**L. MSES Subsurface Drainage System.** Provide underdrain and geotextile material for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

**1. Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 *Underdrains*.

**2. Geotextile Drainage.** Provide geotextile conforming to the requirements of §737-01 *Geotextiles*, Geotextile Drainage, Strength Class 2, Drainage Class B.

**M. MSES Identification Markers**

**1. Signs.** These will be 7 in. x 10 in. (minimum) fiberglass. Include warning information as follows:

**WARNING**  
Internally Stabilized Fill Structure  
**DO NOT EXCAVATE**  
Call Regional Office of NYS DOT

For signs installed on concrete units, provide ¼ in. diameter by 1 ½ in. long stainless-steel nail drive expansion anchors meeting GSA Specifications FF-S-325.

For signs installed on timbers, provide ¼ in. diameter by 1 ½ in. long stainless-steel wood screws.

**2. Marking Tape.** This will be polyethylene material 3 in. wide, 4 mil. thick. Include warning markings.

**554-2.03. Mechanically Stabilized Wall System.** Not all materials listed below are required for each MSWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. MSWS Leveling Pad.** MSWS height is measured from the top of the leveling pad to the top of the face coping unit.

**1. Wall Heights Taller Than or Equal to 15 ft.** For MSWS taller than or equal to 15 ft. in total height, provide a leveling pad of unreinforced Class A concrete - Section 501 *Portland Cement Concrete – General*.

**2. Wall Heights Shorter Than 15 ft.** For MSWS shorter than 15 ft. in total height, provide a leveling pad conforming to one of the following:

**i. Concrete.** Unreinforced Class A concrete - Section 501 *Portland Cement Concrete – General*, or

**ii. Granular.** Select Granular Fill - §733-11 *Select Granular Fill*, or Crushed Stone - §501-2.02, B.1.b. *Coarse Aggregate Type CA-2* in Table 501-2 Coarse Aggregate Gradations.

**3. Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 *Cushion Sand*, in lieu of MSWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

**B. MSWS Facing System.** Provide a facing system in accordance with the requirements below

**1. Solid Face Units.** Provide face units fabricated and conforming to §704-07 *Dry Cast Concrete Wall Units* or §704-06 *Precast Concrete Wall Units* and *Precast Concrete Cribbing*. The default treatment for a MSWS face unit is a split face finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units fabricated and conforming to §704-07 *Dry Cast Concrete Wall Units* or §704-06 *Precast Concrete Wall Units* and *Precast Concrete Cribbing*.

**2. Open Top Face Unit.** Provide face units meeting the requirements of §704-06 *Precast Concrete Wall Units* and *Precast Concrete Cribbing*. The default treatment for a MSWS face unit is a plain, smooth concrete finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units meeting the requirements of §704-06 *Precast Concrete Wall Units* and *Precast Concrete Cribbing*.

**C. MSWS Alignment and Connection Devices.** Provide devices conforming to the designers Installation Manual.

**D. MSWS Joint Fillers.** Fill joints with material meeting the requirements of §705-07 *Premolded Resilient Joint Filler* and approved by the wall system designer.

**E. MSWS Geotextile.** Provide a geotextile meeting the requirements of §737-01B *Geotextile Separation*.

**F. MSWS Slip Joints.** The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

**G. MSWS Reinforcing Element.** Provide geogrid or geotextile reinforcing elements meeting the requirements of §737-07 *Geogrids*.

**H. MSWS Unit Infill.** Provide infill material meeting the requirements of §733-02 *Mechanically Stabilized Earth System Backfill Material*.

**1. MSWS Unit Infill – Coarse Aggregate Option.** For units where the shape impedes the compaction procedures within the area of the bin, provide unit infill material meeting the requirements of §733-02 *Mechanically Stabilized Earth System Backfill Material* that consists of crushed stone with a gradation conforming to §703-02 *Coarse Aggregate*, Size Designation 2 with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%.

**2. MSWS Unit Infill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for MSES Backfill*.

**I. MSWS Backfill.** Provide backfill material meeting the requirements of §733-02 *Mechanically Stabilized Earth System Backfill Material*.

**1. MSWS Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for MSES Backfill*.

**J. MSWS Geomembrane.** Provide a geomembrane meeting the requirements of §737-02 *Geomembranes*.

**K. MSWS Subsurface Drainage System.** Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

**1. Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 *Underdrains*.

**2. Geotextile Drainage.** Provide geotextile conforming to the requirements of §737-01 *Geotextiles*, Geotextile Drainage, Strength Class 2, Drainage Class B.

**3. Prefabricated Composite Structural Drain.** Provide structural drain conforming to the requirements of §737-04 *Prefabricated Composite Structural Drain*.

**L. MSWS Identification Markers.** Provide identification markers conforming to §554-2.02 M. *MSES Identification Markers*.

**554-2.04. Geosynthetically Reinforced Soil System.** Not all materials listed below are required for each GRSS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. GRSS Geosynthetic Reinforcing Element.** Provide a geogrid or geotextile primary and secondary reinforcing elements meeting the requirements of §737-07 *Geogrids*.

**B. GRSS Backfill.** Provide backfill material conforming to the following:

**1. Walls.** Provide backfill material meeting the requirements of §733-14 *Select Structural Fill* with the exception that the pH requirements are waived.

**i. GRSS Wall Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

**2. Slopes.** Provide backfill material meeting the requirements of §733-03 *Geosynthetically Reinforced Soil System Slope Backfill Material*.

**i. GRSS Slope Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

**C. GRSS Wall Facing Foundation.** Provide a pad of material meeting the requirements of §703-02 *Crushed Stone, Size Designation 2*.

**D. GRSS Facing System.** Provide a facing system shown in the contract documents and in accordance with the requirements below.

**1. Welded Wire Forms.** Provide welded wire forms and wire struts as shown in the contract documents, conforming to the material requirements of §709-02 *Wire Fabric for Concrete Reinforcement*. For applications other than staging walls, provide galvanization to the forms in accordance with the requirements of ASTM A 641 Class 3 for zinc coating (including the zinc coating on the Style 2 fabric), ASTM A 856M Class 3 for Zn-5Al-MM coating, or ASTM A 809 for aluminum coating.

Provide geotextile face wrap material meeting the requirements of §737-01B *Geotextile Separation* and as shown in the contract documents.

Proposed alternate, non-structural facing systems used to aid in compaction near the face of the wall shall be included in the submittal outlined in §554-3.03 A. *GRSS Submittal*.

**2. Geocells.** Provide geocells, anchoring devices, and staples as shown in the contract documents, conforming to the material requirements of §737-08 *Geocells*.

Provide infill material conforming to §733-14 *Select Structural Fill*, with the added stipulation that the maximum particle size is 2 in. Where a vegetated face is called for, the outermost cells are to be filled with topsoil meeting the material requirements of §713-01 *Topsoil*.

**3. Timbers.** Provide timbers as shown in the contract documents, graded for an extreme fiber stress of at least 1000 psi conforming to the material requirements of §712-14 *Stress Graded Timber and Lumber*. Treat timbers in accordance with §708-31 *Wood Preservative - Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

**4. As Shown in the Contract Documents.** Provide materials in accordance with the contract documents. Precast units are excluded as a design-specific GRSS facing system,

**E. GRSS Surface Protection.** Provide erosion resistant covering of the finished GRSS slope surface meeting the requirements of §713-07 *Rolled Erosion Control Products and Soil Stabilizers* Class III Type C.

**F. GRSS Subsurface Drainage System.** Provide underdrain and geotextile material for a backfill drainage system conforming to §554-2.02 L. *MSES Subsurface Drainage System*.

**G. GRSS Identification Markers.** Provide identification markers conforming to §554-2.02 M. *MSES Identification Markers*.

**554-2.05. Prefabricated Wall System.** Not all materials listed below are required for each PWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. PWS Leveling Pad.** Provide a leveling pad conforming to the following:

**1. Open Top Face Units.** For PWS utilizing open top face units, provide a leveling pad of unreinforced Class A concrete - Section 501 *Portland Cement Concrete – General*.



For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 *Cushion Sand*, in lieu of PWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

**2. Solid Face Units.** For PWS utilizing solid face units, provide a leveling pad conforming to the requirements of §733-11 *Select Granular Fill* or §501-2.02, B.1.b. *Coarse Aggregate Type CA-2* in Table 501-2 Coarse Aggregate Gradations.

**B. PWS Face Unit.** Provide face units meeting the following:

**1. Open Top Face Units.** For PWS utilizing open top face units, provide units meeting the requirements of §704-06 *Precast Concrete Wall Units and Precast Concrete Cribbing*. The default treatment for a PWS open top face unit is a plain, smooth concrete finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units meeting the requirements of §704-06 *Precast Concrete Wall Units and Precast Concrete Cribbing*.

**2. Solid Face Units.** For PWS utilizing solid face units, provide units meeting the requirements of §704-07 *Dry Cast Concrete Wall Units* or §704-06 *Precast Concrete Wall Units and Precast Concrete Cribbing*. The default treatment for a PWS solid face unit is a split face finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units fabricated and conforming to §704-07 *Dry Cast Concrete Wall Units* or §704-06 *Precast Concrete Wall Units and Precast Concrete Cribbing*.

**C. PWS Joint Fillers.** Fill joints with material meeting the requirements of §705-07 *Premolded Resilient Joint Filler* and approved by the wall system designer.

**D. PWS Geotextile.** Provide a geotextile meeting the requirements of §737-01B *Geotextile Separation*.

**E. PWS Slip Joints.** The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

**F. PWS Backfill.** Provide backfill material meeting the requirements of §733-14 *Select Structural Fill*.

**1. PWS Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

**G. PWS Unit Infill.** Provide unit infill material meeting the requirements of §733-14 *Select Structural Fill*.

For systems which allow plantings to integrate the structure into the surrounding environment, the front pocket of the unit shall be filled with a minimum of 8 in. of topsoil conforming to the material requirements as specified in §713-01 *Topsoil*.

**1. PWS Unit Infill – Coarse Aggregate Option.** For units where the shape impedes the compaction procedures within the area of the bin, provide unit infill material consisting of

crushed stone conforming to §703-02 *Coarse Aggregate*, Size Designation 2 with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%.

**2. PWS Unit Infill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

**H. PWS Subsurface Drainage System.** Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

**1. Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 *Underdrains*.

**2. Geotextile Drainage.** Provide geotextile conforming to the requirements of §737-01 *Geotextiles*, Geotextile Drainage, Strength Class 2, Drainage Class B.

**3. Prefabricated Composite Structural Drain.** Provide structural drain conforming to the requirements of §737-04 *Prefabricated Composite Structural Drain*.

**554-2.06 Fill Type Retaining Wall Aesthetic Treatment.** The requirements for color, texture and pattern will be described in the contract documents using industry-standard descriptions and terminology.

Other requirements will be vividly described in the contract documents using special notes and sketches, as needed.

## 554-3 CONSTRUCTION DETAILS

### 554-3.01. General.

**A. Fill Type Retaining Wall Selection.** Approved designers of proprietary Fill Type Retaining Walls, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Proprietary Fill Type Retaining Walls include Mechanically Stabilized Earth Systems, Mechanically Stabilized Wall Systems, and Prefabricated Wall Systems. Select a designer appearing on the Approved List for Fill Type Retaining Walls. The selection shall be based on the maximum wall height shown in the contract documents.

**B. Fill Type Retaining Wall Submittal.** Obtain from the chosen designer a Fill Type Retaining Wall design stamped by a Professional Engineer. Submit the design package, including working drawings of the wall design, design calculations, and the designers Installation Manual at least 30 work days before starting work to the following:

**1. Mechanically Stabilized Earth System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 *Precast Concrete – General*. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B *Gradation*) suitable for the construction of the wall system, fabrication drawings for precast panels and coping and, for treatments applied to the face panel units other than the default treatment, a face panel unit sample for color and texture approval by the Regional Landscape Architect.

**2. Mechanically Stabilized Wall System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Geotechnical Engineering Bureau. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department's Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B *Gradation*), infill material gradation change, if necessary (outlined in §554-2.03 H.1. *MSWS Unit Infill – Coarse Aggregate Option*) suitable for the construction of the wall system and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

### **3. Prefabricated Wall System.**

**i. Open Top Face Units.** For PWS utilizing open top face units, submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 *Precast Concrete – General*. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department's Approved List. The design package shall also include infill material gradation change, if necessary (outlined in §554-2.05 G.1. *PWS Unit Infill – Coarse Aggregate Option*), fabrication drawings for the face units and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

**ii. Solid Face Units.** For PWS utilizing solid face units, submit the design package to the Engineer for approval. For solid face units consisting of units manufactured via the wet-casting process, submit the design package in accordance with the requirements for Drawing in §704-03 *Precast Concrete – General*. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department's Approved List. For treatments applied to the face units other than the default treatment, the design package submittal shall also include a face unit sample for color and texture approval by the Regional Landscape Architect.

**4. Additional Requirements for Internally Stabilized Fill Structures.** Due to the dependency on the construction methods, progression of panel/unit placement, compaction of reinforced volume, and sequence of panel/unit loading, if an MSES or MSWS is chosen from the Approved List, the following additional requirements are to be included in the Fill Type Retaining Wall design submittal to ensure the successful installation, evaluation, and long-term performance:

**i. Leveling Pad Steps.** Vertical steps in the leveling pad for MSES walls shall not be greater than half the standard panels height and the minimum length of wall between leveling pad elevation changes shall be the width of two standard panels.

Vertical steps in the leveling pad for MSWS shall not be greater than 2.5 ft. and the minimum length of wall between leveling pad elevation changes shall be 10 ft.

**ii. Geomembrane.** If the Contractor elects to provide an Internally Stabilized Fill Structure (either MSES or MSWS) which utilizes inextensible (metallic) reinforcing elements, the design submittal shall include a geomembrane barrier above the top layer of metallic reinforcements to protect the reinforcements from accelerated corrosion rates due to the infiltration of runoff containing deicing salts. If the design requires the geomembrane barrier to be installed at a lower elevation than the top layer of metallic reinforcements, design the reinforcements situated above the geomembrane for an exaggerated service life (and supplied with identification markers for the Inspection Staff).

The details of the geomembrane barrier, including details showing the geomembrane tied into a drainage system to collect and discharge runoff, shall be included in the shop drawings submitted for review and approval. Ensure that the geomembrane will isolate the reinforced mass, will drain away from the MSES face panels/MSWS face units, and that all subsurface drainage has a positive outlet.

The geomembrane shall extend a minimum distance of 5 ft. beyond the length of the reinforcement.

**iii. LiDAR Survey.** After installation, the MSES or MSWS shall be surveyed using terrestrial LiDAR (Light Detection And Ranging) system. The following data should be submitted in duplicate on 2 USB drives:

- Report identifying the established permanent survey control indicating the control method (i.e. RTK GPS, etc.) control locations, registration residuals and control values.
- Raw point cloud in proprietary file format for each laser scan setup.
- Individual scan setup data shall overlap the next scan setup data by no less than 15 ft.
- Individual points in a point cloud shall have less than 0.1 ft. separation horizontally for area of mapping.
- Point cloud with first returns and digital camera overlay.
- Point cloud as a Leica PTS file or ASCII comma delimited file with values X, Y, Z, and intensity for the whole project. The X, Y values should be in the project's mapping horizontal datum projected to the proper state plane coordinate system zone and the Z values shall be in the project's vertical datum. All coordinate values shall have thousandths of a foot precision.

The following data accuracies are required:

- Vertical and Horizontal Point cloud accuracy of 0.08 feet or better on hard surfaces at 95% confidence level using National Spatial Data Accuracy standards as defined in Geospatial Positioning Accuracy Standard for Spatial Data Accuracy Part 3: National Standards for Spatial Data Accuracy.

After receipt of all pertinent information, the Department requires 10 work days or 2 work days per drawing sheet, whichever is greater, to review the submission.

**C. Winter Earthwork.** For Contractors choosing to proceed with earthwork construction operations requiring soil compaction from November 1st thru April 1st, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, in accordance with §203-3.01 A. *Winter Earthwork Submittal*. In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on ground that is frozen to any depth.

Winter earthwork restrictions state that if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork will only proceed using material that meets the requirements of §733-16 *Winter Earthwork* and/or standard earthwork material placement utilizing the modified methods and procedures. Therefore, the Winter Earthwork submittal shall provide details of whether a material change will be used or if methods and procedures will be modified to adjust for the weather influence on the compaction operations. If a material change is proposed, the submittal shall provide details of when the change will occur and how many times the material will change within the construction of the wall.

## **554-3.02. Mechanically Stabilized Earth System.**

**A. Pre-Operation Meeting.** A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate

Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCES written approval and holding the Pre-Operation Meeting.

Supply technical assistance, by a Professional Engineer from the designated Wall System, for consultation throughout the installation of the wall. The technical assistant shall be on-site during the initial installation of the wall panels, during critical installation phases designated at the Pre-Operation Meeting, and as requested by the Engineer. This requirement shall apply for all wall locations depicted in the contract documents.

Subsequent to the completion of the wall but before the start of the work elements above the final top of wall elevation, the technical assistant shall conduct an engineering survey of the wall and provide a report to the Engineer. The report shall contain the following elements:

1. A summary of the work procedures used to construct the wall, including backfill material moisture content, compactive effort/equipment specifications, lift thicknesses, initial panel back-batter, initial bracing techniques.
2. A description of any procedures that deviated from the designers Installation Manual, including the reasoning for the change.
3. An inspection of the wall joints, including offset per panel, gap tolerance, spacers (appropriate use of, and subsequent removal of, temporary wooden wedges, bearing pad placement), and joint fillers/geotextile.
4. An inspection of the wall system, including alignment and overall plumbness of the wall.
5. An account of the wall reinforcing elements, including storage and handling methods, procedures used to attach and fasten reinforcements, methods used to minimize disturbance to compacted material at attachment locations, and technique employed to remove slack.
6. A summary of the field conditions and drainage control, including installation of subsurface drainage system, methods for positive control and discharge of all surface drainage during the walls construction, and any adverse weather impacts to the wall system.
7. An account of the geomembrane installation, including the elevation in relation to the reinforced mass, placement technique, details/materials used at connections to vertical projections extending through the geomembrane, seam sealing method/equipment specifications, installation of subsurface drainage system.
8. Identification of any approved field changes.
9. Remarks on the construction procedure and a conclusion regarding whether or not the completed wall construction has met the designated Wall Systems design and installation requirements.

**B. MSES Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

**C. MSES Foundation.** Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.

**1. Placement Area.** Grade the area under the MSES, level for a width equal to, or in excess of, the distance from a minimum of 3 ft. extending past the MSES face to the end of the reinforcing element length. Prior to wall system construction, compact this area to a minimum of 90% of Standard Proctor Maximum Density. Treat all soils found to be unsuitable, or incapable of being satisfactorily compacted because of moisture content, in a manner directed by the Engineer, in conjunction with the recommendations of the Regional Geotechnical Engineer.

**D. MSES Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and backfill of the MSES to ensure a continuous, uninterrupted system to prevent

the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

**E. MSES Facing Panel Unit Inspection, Storage, and Handling**

**1. Face Panel Units.** An inspection will be made prior to installation to determine if any damage has occurred to the panel unit(s). Handle and store the panel units with care to prevent damage.

**2. Damaged Panel Units.** Repair damaged panel units in a manner approved by the Engineer. Replace panel units that are not repairable at no additional cost to the State.

**F. MSES Leveling Pad.** Provide an unreinforced concrete leveling pad as required by the contract documents. Cast the concrete, in accordance with the requirements Section 555 Structural Concrete, or place the precast leveling pad for the foundation of the MSES to ensure a flat surface for placing the initial course of precast facing panel units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

**G. MSES Erection**

**1. Methods and Equipment.** Install panel units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents.

Prior to installation of the panel units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use. Erection is to begin on the leveling pad at the lowest elevation and proceed in horizontal lifts.

**2. Panel Unit Installation**

*i.* Place panel units such that, after completion of compaction, the tolerances of Table 554-1 *MSES Facing Panel Unit Alignment and Joint Offset Tolerances* are not exceeded. After placement, maintain each panel unit in position. If wedges are used, do not allow them to remain in place below three panel unit heights during installation, and compaction. Remove all wedges remaining in the top three panel unit heights upon completion of the MSES. External braces may be required for initial placements. Install joint fillers in the manner indicated by the Installation Manual.

*ii.* Correct all misalignments of installed panel units in excess of the tolerances allowed by Table 554-1 *MSES Facing Panel Unit Alignment and Joint Offset Tolerances*, at no additional cost to the State.

<b>TABLE 554-1 MSES FACING PANEL UNIT ALIGNMENT AND JOINT OFFSET TOLERANCES</b>	
Horizontal Alignment	± ¾ in./10 ft.
Joint Offset per Panel Unit	± ¾ in.
Overall Vertical Plumbness (Top to Bottom of Wall System)	± ½ in./10 ft.

**H. MSES Backfill.** Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

**1. Moisture Content.** Place backfill materials, other than Type B, at or within 2% dry of the Optimum Moisture Content. Rework or replace all backfill material which is at a moisture content in excess of the Optimum Moisture content. Determine the Optimum Moisture Content in conformance with the latest Geotechnical Test Methods for compaction that incorporate moisture content determination. Rework or replace backfill material at no additional cost to the State.

**2. Backfill Placement.** Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the panel units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.

*i.* Place granular backfill material in uniform layers not exceeding 12 in. loose lift thickness per layer. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.

*ii.* Place Type B backfill in uniform layers not exceeding 16 in. loose lift thickness. Compact in accordance with requirements determined by the Engineer.

*iii.* Place any backfill material in the area within 3 ft. of the panel units in uniform layers not exceeding 6 in. loose lift thickness per layer. Compact in accordance with requirements determined by the Engineer.

**3. Surface Drainage Control.** Provide positive control and discharge of all surface drainage that will affect the installation of the MSES throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

**4. QA Program.** The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 *Mechanically Stabilized Earth System Backfill Material*. If the material is determined to not meet the specification requirements, the material will be rejected.

**5. Geomembrane.** As outlined in §554-3.01.B.4.ii *Geomembrane*, if the MSES reinforced mass requires a geomembrane, install the geomembrane in accordance with §207-3.02 *Geomembranes*.

**I. MSES Reinforcing Elements.** Place reinforcing elements in accordance with the designer's recommendations or as described in the designers Installation Manual. Before attaching the reinforcing elements to the panel units, repair all damage to the zinc coating in accordance with the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

**1. Placement.** Place reinforcing elements normal to the panel units unless indicated otherwise by the contract documents or approved shop drawings. Take care to avoid breaking, distorting, or disturbing the reinforcing elements. Replace reinforcing elements which are broken or distorted.

**2. Connections.** Prior to the attachment of the reinforcing elements, as required, fill all openings, or attachment locations, with grease, or other protective material. Obtain the grease or other protective materials from the chosen designer.

Remove only enough backfill material placed in accordance with §554-3.02 H.2. *Backfill Placement* to properly join and secure the connection. Connect reinforcing elements to the face panel unit before placement of subsequent face panel units, or as directed by the approved shop drawings.

**3. Reinforcing Elements.** All soil reinforcing elements shall be vertically separated from other reinforcing elements by a minimum of 3 in.

**J. MSES Identification Markers.** Install MSES identification markers.

Place the marking tape at the highest possible elevation that will not damage the tape. For walls supporting a pavement section, install the tape 6 in. below top of subbase elevation. For walls supporting earth, install the tape 6 in. below finished grade. Install the marking tape on top of the reinforced backfill area, parallel to the wall face in rows at 5 ft. intervals until the back edge of the reinforced backfill area is reached.

Drill two, 5/16 in. diameter, holes for mounting, located ½ in. from the ends of the sign and 3 ½ in. from the top of the sign. Secure the sign using anchorage appropriate for the supporting material.

**K. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to MSES shall be done at the Contractor's risk. Govern the operations and procedures to prevent misalignment of the installed panel units. Precautionary measures include, but are not limited to, keeping vehicular equipment a minimum of 3 ft. from the panel units. Within 3 ft. of the panel units use compaction equipment meeting the requirements of *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designers written instructions at no additional cost to the State.

### **554-3.03. Mechanically Stabilized Wall System.**

**A. Pre-Operation Meeting.** A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCETS written approval and holding the Pre-Operation Meeting.

Supply on-site technical assistance and an engineering survey report on the wall in accordance with §554-3.02 A. *Pre-Operation Meeting*.

**B. MSWS Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

**C. MSWS Foundation.** Prepare the foundation in accordance with the requirements of §554-3.02 C. *MSES Foundation*.

**D. MSWS Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and infill/backfill of the MSWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

**E. MSWS Leveling Pad.** Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.



**1. Concrete.** Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the MSWS.

**2. Granular.** Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

**F. MSWS Facing Unit Erection**

**1. Methods and Equipment.** Install face units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents. Prior to installation of the face units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use. Erection is to begin on the leveling pad at the lowest elevation and proceed in horizontal lifts.

**2. Solid Face Unit Erection**

*i.* Install by placing, positioning, and aligning face units in conformance with the designers Installation Manual and within the tolerances in Table 554-2 *MSWS Solid Face Unit Alignment Tolerances*.

*ii.* Correct all misalignments of installed face units that exceed the tolerances allowed in Table 554-2 *MSWS Solid Facing Unit Alignment Tolerances*.

<b>TABLE 554-2 MSWS SOLID FACE UNIT ALIGNMENT TOLERANCES</b>	
Vertical Control	± ¼ in. over a distance of 10 ft.
Horizontal Control	± ½ in. over a distance of 10 ft.
Rotation from established plan wall batter	± ½ in. over a distance of 10 ft.

**2. Open Top Face Unit Erection.** During erection, any face unit damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.

*i.* All face units shall be assembled and handled in accordance with the designer’s instructions and the contract documents. Erect the face units conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer’s installation manual.

*ii.* Place the face units side by side and in full contact with the installed leveling pad.

*iii.* Maintain the minimum face unit tolerances shown in Table 554-3 *MSWS Open Top Face Unit Tolerances*. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer:

<b>TABLE 554-3 MSWS OPEN TOP FACE UNIT ALIGNMENT TOLERANCES</b>	
Vertical Control (plumbness)	± ¾ in. over a distance of 10 ft.
Horizontal Location Control (alignment)	± ¾ in. over a distance of 10 ft.
Vertically overall (plumbness from top to bottom)	± ½ in. over a height of 10 ft.

*iv.* Adjust face unit spacing for curved sections according to the manufacturer's installation recommendations.

## **G. MSWS Facing Unit Bin Infill**

### **1. Solid Face Unit Bin Infill**

**i. Placement.** Place unit infill to the limits indicated in the contract documents. Before installing the next course of face units, compact the unit infill and brush the tops of the face units clean to ensure an even placement area.

**ii. Protection.** Protect unit infill from contamination during construction.

### **2. Open Top Face Unit Bin Infill.**

**i. Placement.** Place and compact backfill and face unit infill simultaneously with the erection of the PWS and in accordance with *Compaction* in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

**ii. Protection.** Protect unit infill from contamination during construction.

**H. MSWS Backfill.** Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

**1. Moisture Content.** Place backfill materials (other than Types B and D) at or within 2% dry of the Optimum Moisture Content. Rework or replace all material which is at a moisture content exceeding the Optimum Moisture Content. Determine Optimum Moisture Content in conformance with Geotechnical Test Methods (excluding GTM-6) for compaction that incorporates moisture content determination. Rework or replace backfill material at no additional cost to the State.

**2. Backfill Placement.** Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the face units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.

**i.** Place granular backfill material in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.

**ii.** Place Type B backfill in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer in conformance with *Compaction* in Section 203 Excavation and Embankment.

**3. Separation Geotextile.** Place the geotextile separation, if required, loosely but in intimate contact with the soil so that placement of the overlying material will not stretch or tear the geotextile.

**4. Surface Drainage Control.** Provide positive control and discharge of all surface drainage that will affect the installation of the MSWS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

**5. QA Program.** The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 *Mechanically Stabilized Earth System Backfill Material*. If the material is determined to not meet the specification requirements, the material will be rejected

**6. Geomembrane.** As outlined in §554-3.01.B.4.ii *Geomembrane*, if the MSWS reinforced mass requires a geomembrane, install the geomembrane in accordance with §207-3.02 *Geomembranes*.

### **I. MSWS Reinforcing Element**

**1. Reinforcing Element Placement.** Place the reinforcing element normal to face units unless otherwise indicated in the contract documents. Replace all broken, damaged or distorted reinforcing elements at no additional cost to the State.

**2. Reinforcing Element Connection.** Install the reinforcing element within/between courses of face units conforming to the designers Installation Manual. Pull taut and secure the reinforcing element before placing the backfill.

**J. MSWS Identification Markers.** Install MSWS identification markers in accordance with the requirements of §554-3.02 J. *MSES Identification Markers*.

**K. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to MSWS shall be done at the Contractor's risk. Control all operations and procedures to prevent misalignment of the face units. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designers written instructions at no additional cost to the State.

### **554-3.04. Geosynthetically Reinforced Soil System.**

**A. GRSS Submittal.** Submit the geogrid or geotextile reinforcing element certifications, verifying that the material meets the requirements of §737-07 *Geogrids* for the specified long-term design tensile strength shown in the contract documents, to the Engineer prior to start of work. Begin work only after receiving the Engineer's approval.

**B. GRSS Storage of Geosynthetic.** Store and protect geosynthetic materials in accordance with the manufacturer's recommendations prior to installation.

**C. GRSS Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

**D. GRSS Foundation.** Prior to erection of the GRSS system, the foundation shall be inspected and approved by the Engineer.

Grade the area under the GRSS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.

For GRSS wall systems, a pad of crushed stone shall be incorporated into the foundation directly below the wall facing.

**E. GRSS Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and backfill of the GRSS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

**F. GRSS Placement of Materials.**

**1. Geosynthetic Reinforcing Element.** Place and secure the primary and secondary reinforcing element in accordance with the manufacturer's recommendations, in continuous strips without joints, seams or connections throughout the embedment length, to the line, grade and orientation shown in the contract documents. Place reinforcing elements to lay flat with no creases and pull taut to remove any slack prior to placement of backfill.

**2. Welded Wire Forms.** Place welded wire forms where required, as shown in the contract documents. Position and connect the welded wire forms to overlap 2 in. with adjacent forms and connect with wire ties. Install wire struts as shown in the contract documents and as required to stiffen the welded wire forms.

**3. Geotextile Face Wrap.** Place geotextile face wrap as shown in the contract documents. If used in conjunction with welded wire forms, place the geotextile face wrap so as to conform closely to the welded wire forms.

**4. Backfill.** Replace any damaged geosynthetic prior to placement of any overlying material at no cost to the State. Place the backfill onto the geosynthetic reinforcing elements in such a manner that no damage occurs. Progress placement of backfill materials so as to minimize the development of slack in the reinforcing element. The thickness of a compacted lift of backfill is not to exceed 12 in. or the measured vertical distance between geosynthetic layers, whichever is less. Compact the backfill to a minimum of 95% of Standard Proctor Maximum Density in accordance with the requirements contained in *Compaction* in Section 203 Excavation and Embankment. Only hand operated equipment is allowed within 3 ft. of the face. Lift thickness may have to be reduced to achieve required compaction.

**5. Surface Protection.** Place and secure erosion control material in accordance with Section 209 *Soil Erosion and Sediment Control* and as shown in the contract documents.

**6. Permanent Facing.** Place and connect permanent facing as shown in the contract documents.

**7. Surface Drainage Control.** Provide positive control and discharge of all surface drainage that will affect the installation of the GRSS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

**G. GRSS Construction Monitoring.** Monitor the system face during fill placement and compaction. If verticality or the required batter of a system is not being maintained, stop work until compaction equipment and/or operational procedures are modified.

**H. GRSS Identification Markers.** For applications other than staging walls, install GRSS identification markers in accordance with the requirements of §554-3.02 J. *MSES Identification Markers*.

**I. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to GRSS shall be done at the Contractor's risk. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in accordance with the manufacturer's written instructions at no additional cost to the State.

### **554-3.05. Prefabricated Wall System.**

**A. PWS Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the contract documents.

**B. PWS Foundation.** Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.

Grade the area under the PMWS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.

Construct the wall system to meet the line and grade shown in the contract documents.

**C. PWS Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and infill/backfill of the PWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, install the subsurface drainage system to drain all intercepted water to a point of positive drainage.

**D. PWS Leveling Pad.** Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

**1. Concrete.** Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the PWS.

**2. Granular.** Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

**E. PWS Erection.** During erection, remove and replace any face units damaged beyond repair with approved face units at no additional cost to the State.

**1. Assembly.** All PWS shall be assembled and handled in accordance with the designer's instructions and the contract documents. Erect the PWS conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer's installation manual.

**2. Placement.** Place the PWS side by side and in full contact with the installed leveling pad.

**3. Tolerances.** Maintain the minimum PWS tolerances shown in Table 554-2 *MSWS Solid Face Unit Alignment Tolerances* or Table 554-3 *MSWS Open Top Face Unit Alignment Tolerances* as appropriate. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer:

**4. Adjustments.** Adjust PWS spacing for curved sections according to the manufacturer's installation recommendations.

**5. Coping.** Apply the coping unit to the top of the wall using mastic adhesive, in accordance with, and conforming to the unit manufacturer's installation recommendations.

**F. PWS Infill and Backfill.** Immediately prior to backfilling, the Engineer will inspect the face units for damage. Face units which are damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.

Place and compact backfill and unit infill simultaneously with the erection of the PWS and in accordance with *Compaction* in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

**G. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to PWS shall be done at the Contractor's risk. Control all operations and procedures to prevent misalignment of the PWS. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to the *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Any damage to face units from any cause shall be repaired or replaced by the Contractor at no additional cost to the State.

**554-3.06 Fill Type Retaining Wall Aesthetic Treatment.** Provide aesthetic treatment as specified in the contract documents. Any damage to the treatment shall be repaired to the satisfaction of the Engineer at no additional cost to the State.

#### **554-4 METHOD OF MEASUREMENT.**

**554-4.01. General.** Vacant.

**554-4.02. Mechanically Stabilized Earth System.** A MSES will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.03. Mechanically Stabilized Wall System.** A MSWS will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.04. Geosynthetically Reinforced Soil System.** A GRSS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.05 Prefabricated Wall System.** A PWS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.06 Fill Type Retaining Wall Aesthetic Treatment.** Aesthetic treatment will be measured in square feet of treated face area, measured to the nearest square foot from the payment lines shown in the contract documents. Include only those visual standards incorporated into the finished wall into the measurements.

## 554-5 BASIS OF PAYMENT

**554-5.01. General.** Vacant.

**554-5.02 Mechanically Stabilized Earth System.** Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, reinforcing elements, leveling pads, fasteners, joint fillers, geotextiles, face panel and coping units, subsurface drainage system, geomembrane, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

**554-5.03 Mechanically Stabilized Wall System.** Include in the unit price bid the cost of all labor, material, and equipment, including backfill, infill, reinforcing elements, leveling pads, fasteners, geotextiles, face units and coping units, subsurface drainage system, geomembrane, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

**554-5.04 Geosynthetically Reinforced Soil System.** Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, geosynthetic reinforcing elements, facing system, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

**554-5.05 Prefabricated Wall System.** Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, infill, leveling pads, joint fillers, geotextiles, face units and coping units, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

**554-5.06 Fill Type Retaining Wall Aesthetic Treatment.** Include in the unit price bid the cost of all labor, material, and equipment needed to provide aesthetic treatment for the wall and the cost of production and transportation of visual standards from the precast facility to the project site for Region approval and back to the precast facility for use during production.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
554.30XX	Geosynthetically Reinforced Soil System Wall	Square Feet
<u>XX</u>	<u>Facing System</u>	
01	Welded Wire Forms	
02	Geocells	
03	Timbers	
05	Other; As Shown in the Contract Documents	
554.31	Geosynthetically Reinforced Soil System Slope	Square Feet
554.40	Fill Type Retaining Wall (0 – 6 ft.)	Square Feet
554.41	Fill Type Retaining Wall (Greater than 6 ft. – 12 ft.)	Square Feet
554.42	Fill Type Retaining Wall (Greater than 12 ft. – 18 ft.)	Square Feet
554.43	Fill Type Retaining Wall (Greater than 18 ft. – 24 ft.)	Square Feet
554.44	Fill Type Retaining Wall (Greater than 24 ft. – 30 ft.)	Square Feet
554.45	Fill Type Retaining Wall (Greater than 30 ft.)	Square Feet
554.5001	Fill Type Retaining Wall Aesthetic Treatment - Textured Surface (Hand Tooled, Raked, etc.), No Color	Square Feet

554.5002	Fill Type Retaining Wall Aesthetic Treatment - Textured Surface (Hand Tooled, Raked, etc.), Integral Color	Square Feet
554.5101	Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, No Color	Square Feet
554.5102	Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, Integral Color	Square Feet
554.5201	Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, No Color	Square Feet
554.5202	Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, Integral Color	Square Feet
554.53	Fill Type Retaining Wall Aesthetic Treatment - Other; As Shown in the Contract Documents	Square Feet

## SECTION 555 - STRUCTURAL CONCRETE

**555-1 DESCRIPTION.** This work shall consist of furnishing and placing portland cement concrete for structures as indicated in the contract documents and as directed by the Engineer.

### 555-2 MATERIALS

**555-2.01 General.** The materials used for structural concrete shall comply with the material requirements of Section 501, Portland Cement Concrete, General.

Additional materials, listed below, required specifically for use in conjunction with structural concrete items shall meet the requirements of the following subsections:

Concrete Grout Material	701-05
Vertical and Overhead Patching Material	701-08
Rapid Hardening Concrete Repair Material	701-09
Concrete Repair Material - High Early Strength	701-12
Preformed Cork Joint Filler	705-01
Preformed Rubber Joint Filler	705-03
Caulking Compound for Structures	705-06
Preformed Elastic Bridge Joint Sealer	705-09
Polyvinyl Chloride Extruded Shapes and Sheet Material	705-11
Lubricant for Preformed Elastic Joint Sealer	705-13
Bar Reinforcement, Grade 60	709-01
Wire Fabric for Concrete Reinforcement	709-02
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Polyethylene Curing Cover (White Opaque)	711-04
Membrane Curing Compound	711-05
Burlap	711-06
Form Insulating Materials for Cold Weather Concreting	711-07
Admixtures	711-08
Water	712-01
Asphalt Roofing Felt	712-12
Epoxy Resin System	721-01
Epoxy Polysulfide Grout	721-03
Copper Flashing	725-01
Sheet Gasket (treated both sides)	728-06
Concrete Cylinder Curing Box	735-01



**555-2.02 Concrete for Structures.** The class of concrete required for the various structural concrete items will be indicated in the contract documents. Mixtures using a CA2 gradation shall be used when the minimum placement dimension is 5 inches or greater, except for pedestal repairs, where Class D or DP concrete may be used when placement dimensions are greater than 1½ inches but do not exceed 12 inches. The same source of aggregates shall be used for all faces and surfaces of concrete exposed to view.

### **555-3 CONSTRUCTION DETAILS**

**555-3.01 Concrete Manufacturing and Transportation.** Unless otherwise specified in the contract documents, the construction details for manufacturing and transporting concrete shall comply with §501-3, Portland Cement Concrete - Construction Details.

**555-3.02 Falsework.** Falsework plans shall be submitted by the Contractor and approved by the Engineer before falsework construction is started. Falsework or centering shall be designed for the dead load of the concrete forms, the dead load of the plastic concrete (based on 150 pcf) and a live load resulting from a weight of 50 psf applied to all horizontal surfaces.

Falsework which cannot be founded upon a solid footing, shall be supported by falsework piling.

Screw jacks or hardwood wedges may be required for falsework centering or to take up any slight settlement in the form work, either before or during the placing of concrete.

Falsework shall be set to give the finished structure the specified camber, plus allowance for shrinkage and settlement.

#### **555-3.03 Forms.**

**A. General.** All forms shall be well constructed, carefully aligned, substantial, and firm, securely braced, and fastened together in their final position. They shall be strong enough to prevent the fresh concrete from bulging the forms between supports and to withstand the action of mechanical vibrators. If required by the Engineer, form work plans shall be submitted by the Contractor and approved by the Engineer before forms can be used on the work.

Forms shall be designed to resist a dead load resulting from a weight of 150 pcf for the plastic concrete and a live load resulting from a weight of 50 psf on horizontal surfaces. The form and falsework design shall provide for the loads resulting from any conveyance system in addition to the live load.

When concrete is transported by buggies, conveyor belt, or other approved methods of conveyance, the forms shall be capable of supporting the distribution equipment and any concentrations of concrete which may occur during transportation and distribution. Buggy runways and other supporting platforms shall be supported directly by the forms.

Forms shall be adequately braced to resist concrete design loads. If the forms are inadequately braced concrete placement shall stop until adequate bracing has been provided.

All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall be maintained to eliminate the formation of joints due to shrinkage of the lumber. Forms shall be sufficiently tight to prevent leakage of mortar.

Forms may be constructed of wood, metal, or other approved materials, except when a particular material is specified in the contract documents. The use of fiber forms will be permitted for round columns only if the interior surface of the forms have been treated in such a manner as to prevent helical corrugation marks on the finished concrete surfaces. Forms shall be filleted 1 inch with forming material at all exposed corners to create a chamfer in the finished concrete unless otherwise shown in the contract documents.

When curved, patterned, or other special forms are required, the Contractor shall submit details of the form construction to the Engineer for approval prior to constructing the forms. Forms shall be so constructed that those surfaces on which finishing may be required may be stripped without disturbing the remaining forms. Premanufactured formliner panels, if used, shall be capable of imprinting the surface of the concrete with a uniform and aligned pattern and texture. The panels shall be composed of elastomeric urethane, polyvinyl chloride (PVC), ABS plastic, or other suitable material for their intended shape and number of reuses to achieve the desired effects. Formliners shall leave crisp, sharp definition of the architectural surface. Sufficient liners shall be used to minimize pattern repeat. Formliners shall not compress more than 1/4 inch when concrete is poured at a rate of 10 vertical feet per hour.

Any metal ties or anchorages within the forms shall be so constructed that the embedded portion of the ties can be removed to a depth of at least 2 inches from the surface of the concrete without damage to such surface. Wire ties shall not be used without written approval of the Engineer. In case wire ties are approved, all wires, upon removal of the forms, shall be cut back at least 1/4 inch from the face of the concrete with sharp chisels or nippers (nippers are necessary for green concrete). All cavities produced by the removal of metal ties shall be filled in conformance with requirements of §555-3.11, Corrective Finishing.

For walls where access to the bottom of the forms is not practicable, the lower form boards or panels shall be left loose so that the inside of the forms can be readily cleaned of all chips, dirt, sawdust, or other extraneous material, immediately prior to the placing of concrete.

Forms to be reused shall be maintained in good condition as to accuracy of shape, strength, rigidity, watertightness, and smoothness of surface. Any warped or bulged forms must be carefully resized before being re-used. Forms that are unsatisfactory in any respect shall not be used. All form surfaces that will be in contact with the concrete shall be thoroughly treated with an approved form coating in the manner, and at the rate specified by the manufacturer. Only those coatings listed on the Approved List published by the Materials Bureau are acceptable. Forms so treated shall be protected against damage or dirt prior to placing concrete.

If metal forms are used, the material shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without damage to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease, or other foreign matter that would tend to discolor the concrete.

***B. Foundation Concrete.*** The footings of structures shown in the contract documents shall be considered as approximate only, and when ordered in writing by the Deputy Chief Engineer (Structures), shall be changed to such dimensions as will give a satisfactory foundation. Concrete shall not be placed in any foundation form without the Engineer's approval.

#### **555-3.04 Handling and Placing Concrete.**

***A. Placement Limitations.*** No concrete shall be placed when the ambient air temperature is below 45°F, unless the Engineer grants approval to a written proposal from the Contractor. No concrete shall be placed during rain.

When concrete is to be placed in contact with steel members, reinforcing steel, or previously placed concrete, the temperature of the steel and concrete shall be raised to approximately 45°F. The use of enclosures and heating equipment, including but not limited to the use of forced hot air, hot water boilers, and hoses, or other methods suitable to the Engineer, may be required before concreting begins.

When concrete is to be placed in contact with earth or rock, within piles, or for tremie placements, the temperature of the earth or rock shall be 35°F or higher. The earth or rock shall not have any

snow, ice, frost, or standing water on its surface. The use of insulating materials and heating equipment may be required before concreting begins.

**B. Conveyance.** Concrete shall be placed so as to avoid segregation of materials and displacement of reinforcement. All equipment used for conveying the concrete mix, from the point of delivery and material acceptance to the discharge point, shall be capable of meeting the permissible variations given in Table 555-1, Concrete Conveyance Uniformity. Prior to the actual placement of concrete, the Contractor shall demonstrate the capability of the equipment to convey the concrete mixture. Tests according to Department written instructions will be performed by, and at the discretion of the Engineer. No further verification of the equipment capability will be required unless evidence of nonuniform concrete is observed during placement.

When concrete pumps are used, the lines shall have a minimum diameter of 5 inches. Concrete pumps with smaller hose diameters may be used for small placements, where mixtures using a CA1 gradation (smaller aggregates) are allowed, and where access is limited. The pumping operation shall be performed in such a manner as to discharge concrete horizontally a minimum distance of 3 feet. Where horizontal discharge is not possible, the use of double 90-degree bends at the end of the pump hose, reducer hoses, or other equipment capable of maintaining a head of concrete in the pump line may be allowed, subject to the approval of the Director, Materials Bureau.

All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each use. Water used for flushing shall be discharged clear of the concrete already in place.

Concrete shall not come in contact with any aluminum during conveying and placing operations.

<b>TABLE 555-1 CONCRETE CONVEYANCE UNIFORMITY</b>		
<b>Test</b>		<b>Permissible Variation (Concrete samples taken at two locations in the handling process)</b>
Air Content, % by volume of Concrete		1.5%
Slump	Average slump 4 inches or less	1 inch
	Average slump greater than 4 inches	1 1/2 inches

**C. Acceptance/Testing.** The concrete mixture, prior to placement into the conveying equipment, shall meet the specified requirements for air content and slump given for the various classes and types of placement under Table 501-3, Concrete Mixtures.

**D. Placement.** All foreign matter of every kind shall be removed from the interior of the forms before placing concrete. Temporary studs or braces within the forms shall be removed when the concrete has reached an elevation rendering their further use unnecessary. Dropping concrete a distance of more than 5 feet or depositing a large quantity at any point and running or working it along the forms shall not be permitted. Dropchutes shall be used between vertical forms unless conveyance equipment can be inserted between forms.

Special care shall be taken to fill each part of the form by depositing concrete directly into the form as near to its final position as possible, to work the coarser aggregates back from the face of the concrete and to force the concrete under and around the reinforcement without displacing the reinforcement. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of the projecting reinforcement.

Concrete shall be placed in horizontal layers not more than 1 foot thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding layer has taken

its initial set to prevent damage to the green concrete and avoid cold joints between batches. Each layer shall be consolidated using appropriate vibrating practices so as to avoid the formation of a joint with a preceding layer which has not taken initial set.

When concrete placement is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a depth sufficient to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smooth and level whenever concreting is discontinued. Where a "feather edge" would be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall be continuous from the bottom to the top of any face.

When embedding structural shapes in concrete, the placement of concrete shall be progressed on one side of the shape only until it flushes up over the bottom flange of the shape on the opposite side, after which concrete shall be placed on both sides to completion.

**E. Vibration.** During and immediately after deposition, concrete shall be thoroughly consolidated by vibrating the concrete internally with mechanical vibrating equipment. The use of external vibrators will be permitted when satisfactory surfaces cannot be obtained by internal vibration alone or when it is impossible to use internal vibrators. The use of external vibrators shall be subject to the approval of the Engineer. External vibrators shall be attached to or held on the forms in such a manner as to effectively vibrate the concrete in a horizontal plane.

Internal mechanical vibrators shall be adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and shall produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. If any of the reinforcing steel has epoxy coating, an internal mechanical vibrator shall have a rubberized or elastomeric cover to prevent damage to the epoxy coating on the reinforcing bars. The vibrators and covers shall be inspected for defects prior to use.

A sufficient number of vibrators shall be employed, so that at the required rate of placement, thorough consolidation occurs throughout the entire volume of each layer of concrete. Extra vibrators shall be on hand for emergency use and when other vibrators are being serviced.

The vibrating element shall be vertically inserted in the concrete mass at a depth sufficient to vibrate the bottom of each layer effectively inserting the vibrator into the underlying lift. It shall be withdrawn completely from the concrete before being advanced to the next point of application.

Internal vibrators shall not be placed directly on the forms or the reinforcing steel. The vibratory element shall be inserted vertically into the concrete at the point of deposit and in areas of plastic concrete at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. The time of vibration shall be of sufficient duration to accomplish thorough consolidation, complete embedment of the reinforcement, produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles and to work the concrete into all angles and corners of the forms however, over-vibration shall be avoided. Vibration shall be continued in one place until the concrete has become uniformly plastic, but not to the extent that pools of grout are formed.

Vibration shall be supplemented by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Vibrators shall not be used to push or distribute the concrete laterally.

### **555-3.05 Depositing Structural Concrete Under Water.**

**A. General.** Use a tremie tube, pipeline, or similar method to place concrete under 32 - 90°F water in one continuous operation. Since the tremie tube and the pipeline are both tubes, the word "tube" in

this specification refers to either type, except where specific reference is made to either the tremie tube or the pipeline.

Unless noted differently on the plans, use Class G concrete as described in Table 501-3, Concrete Mixtures. Substitute Class GG Concrete when clear openings between closely spaced objects such as reinforcement bars are less than 3 inches. Pozzolan replacement may be omitted for small placements in a fresh water environment when approved by the DCES.

In addition to §555-3.03 Forms, place concrete on prepared areas cleaned of all debris, mud, or other unsuitable material.

Submit a list of equipment, including back-up, and a schedule for transporting and placing concrete, to the Engineer for review at least 20 working days prior to concrete placement. The Contractor shall be responsible to design a tremie placement, with appropriate forming, that maintains a minimum vertical rise of 1 foot per hour for the overall area and a minimum placement rate of 40 cubic yards per hour, unless fluid concrete pressure requires a reduced placement rate.

Place fresh concrete before stiffening and initial set of the adjacent concrete to ensure a good bond and avoid cold joints. If a delay occurs, determine stiffening and initial set by probes or other methods approved by the Engineer. Stop the operation if the placement cannot be continued before initial set of the adjacent concrete. The Engineer will then immediately contact the DCES.

**B. Methods of Placement.** The tremie tube and pump and pipeline are the most common methods. Obtain approval of the DCES for any other method.

**1. Tremie Tube Method (Open System).** This method uses a vertical tube open at the top, where concrete is delivered to the top and falls down the tube.

a. Tremie tube size shall be based on the delivery system used by the Contractor.

<b>Delivery System</b>	<b>Inside Diameter</b>
Large volume, such as crane and bucket	10 inches minimum
Small volume, such as pump line or conveyor	5 inches minimum

b. Use a sturdy hopper or funnel with a bottom opening smaller than the tremie tube diameter to transfer concrete into the tremie tube. The capacity and shape of the hopper or funnel depends on the volume and type of concrete delivery system. A device with the same size bottom opening may be used if a 1 1/2 to 2 inch diameter breather tube is installed to reach 1 foot or more down into the tremie tube.

c. Install a safe work platform at the top of the tremie tube.

**2. Pump and Pipeline Method (Closed System)** This method uses a vertical tube, attached to a closed tube system, where concrete is pumped to the top and falls down the tube.

a. Use pipe with a minimum inside diameter of 5 inches.

b. Install a minimum 2 inch diameter air vent or valve connection, or leave the pipe joint loose without a gasket, near the high point of the downgrade, 1 to 4 feet below the point where concrete starts falling down the pipe, to allow air displaced by concrete to escape, and admit air to prevent a siphoning effect.

c. Class G concrete, the mix noted on the plans, or a “cement-water” grout may be used for pipeline lubrication and placed in the forms. Waste any other concrete mix used to lubricate pipeline.

**C. Placement Tubes for Tremie Tube or Pump and Pipeline Method.** Clearly mark each tube in at least 1 foot increments (numbered every 5 feet) to show depth to the outlet. Use watertight joints. Place tubes no more than 15 feet from the forms and no more than 30 feet on center.

**1. Open end tubes** Install a separate tube at each placement point, as loss of seal occurs when the embedded end of this tube type is removed from fresh concrete under water. Once started, do not relocate or remove open end tubes until completion of the concrete placement at that location. If loss of seal occurs, remove and seal the tube with a watertight plate or plug for restarting. Restart tremie placement only if a seal can be reestablished using a dewatered tube where the outlet can be surrounded by fresh concrete.

**2. End-valve sealed tubes** Install the number of tubes based on the minimum placement rate defined in A. General, as the seal is maintained when the embedded end of this type is removed from fresh concrete under water. Raise the end of the tube to about 3 feet below the fresh concrete surface. Then, close the valve with the tube 1/2 full of concrete (1/2 the water depth), and slowly remove the tube. Reverse this procedure upon relocation in fresh concrete.

**D. Dewatering.** When necessary, proceed with dewatering at least 4 days after completion of concrete placement, unless noted differently on the Contract Plans or as ordered by the Engineer. After dewatering, continue curing and excavate one or more sumps to provide for pumping of accumulated water. Excavate sumps outside of areas which will receive new concrete, or as approved by the Engineer.

**E. Concrete Evaluation.**

**1. Nondestructive Testing.** Use as directed by the Contract, or as approved by the DCES.

**2. Cores.** Obtain cores in the presence of the Engineer at locations and to depths shown on the contract plans. Take NX size (2 1/8 inch) cores, no earlier than 7 days after concrete placement, according to §648-3.04, Rock Core Samples, B. Sampling, the 1st sentence. Use drill bits meeting the requirements of Subsection 732-06, Coring Bits.

Obtain 100% recovery from each core hole, as less is presumed to indicate defective concrete. Use a 5 foot nominal length of core drill run. Record core boring log data in accordance with §648-3.01B, Driller's Logs.

Label and pack all cores according to §648-3.04 C, Marking, Packaging and Transporting Samples. Deliver and store the core boxes at a site approved by the Engineer, where they become the property of the Department. Provide assistance in moving and arranging core boxes at the site to facilitate evaluation by the Department.

**F. Defects.** Obtain additional cores for further investigation from areas which contain voids, honeycombing, seams, or other defects. The DCES will determine the number and location of additional core holes. Repair defects with grout when approved by the DCES. Placements with defects determined to be unrepairable by grouting will be rejected. Alternate repair techniques require DCES approval.

**G. Grout Repairs and Grout Placements.** This section only applies for underwater grout placements limited to quickly filled areas, such as core drill holes, small piles up to 1 foot in diameter, and other small voids. Use materials meeting §701-05, Concrete Grout Material, for the grout proportioned as specified or as approved by the DCES.

When the DCES grants approval for repairs, the proposed grouting method shall be performed by cleaning out and filling all defects and core drill holes with grout. Position a grout tube (2 inches or

less in diameter) about 1 inch off the bottom of the prepared hole until the grouting operation is complete. Start pumping (closed system) or filling a tremie tube (open system) faster than the grout can fall through water. Continue placing grout until the grout coming back out the hole is the same consistency as that going in. Then withdraw the tube.

Additional cores may be required to verify acceptable repairs.

**H. Tremie Construction Joints.** Prepare the top area of the placement receiving new concrete to within 3 inches of the elevation shown on the plans. When joining fresh concrete to concrete that has already set, the concrete in place shall have its surface scoured or abraded with a suitable tool to remove all loose and foreign materials. After the surface preparation, the concrete surface, and all porous surfaces to be in contact with new concrete shall be thoroughly wet using potable water for 12 hours with soaker hoses or the use of burlap/burlene/etc. to maintain moisture. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated, surface-dry condition until placement of the new concrete.

Fill any low areas with a leveling course of Class A concrete (or Class D for 1 1/2 to 5 inches thick placements).

Fill sumps with concrete or stone, as ordered by the Engineer.

### **555-3.06 Concrete Joints.**

**A. Construction Joints.** Construction joints for the purpose of these specifications are joints used to provide for interruptions in the placement of concrete. Construction joints shall be placed only where shown in the contract documents or where approved by the Deputy Chief Engineer (Structures). Bulkheads required during placement shall be constructed at the direction of the EIC.

Unless otherwise shown in the contract documents, a shear key shall be provided at each construction joint by embedding water-saturated wooden blocks in the plastic concrete. The shear key thus provided shall be approximately 1/3 of the width of the parts joined. The key depth shall equal the thickness of standard form lumber, approximately 1/2 the key width. Shear keys need not exceed 5 1/2 inches in depth regardless of the key width.

On steel truss or open-spandrel, concrete arch spans, unless otherwise noted in the contract documents, the concrete in the floor system shall be placed about the center line of the span, beginning at the center and working simultaneously toward each end; or beginning at the ends, and working simultaneously toward the center. Care shall be taken to prevent the displacement of reinforcement during the placing of concrete. If, for any reason, it becomes necessary to introduce a construction joint, this shall be formed by means of a vertical bulkhead so constructed as to produce a key joint, placed as shown in the contract documents or as permitted by the Deputy Chief Engineer (Structures).

When joining fresh concrete to concrete that has already set, the concrete in place shall have its surface scoured or abraded with a suitable tool to remove all loose and foreign materials. After the surface preparation, the concrete surface and all porous surfaces to be in contact with new concrete shall be thoroughly wetted, to achieve a saturated surface dry condition, using potable water for 12 hours with soaker hoses or the use of burlap/burlene/etc., to maintain moisture. If conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface-dry condition until placement of the new concrete. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete already in place.

Forms for female shear keys shall be beveled on four sides to facilitate their removal and shall be securely fastened to the forms to prevent displacement before the concrete has set. Key forms shall be removed in such a manner as to avoid damage to the concrete.

**B. Contraction Joints.** Contraction joints shall be placed at locations shown in the contract documents and unless otherwise specified, shall be formed the same as construction joints, except that reinforcement shall not extend through the joint.

**C. Expansion Joints.** Expansion joints shall be placed as shown in the contract documents. Expansion joints shall provide for expansion, contraction, and the transfer of shear at the joint, unless otherwise specified. When expansion joints are formed by the insertion and subsequent removal of joint templates, this work shall be done in such a manner that joint edges are not chipped or broken down in the process.

When concrete is to be placed against a joint filler, holes or joints in the filler shall be suitably filled with mastic to prevent mortar or concrete from entering the joint and restricting its movement. The face edges of all joints shall be carefully finished or formed true to line and elevation for a minimum distance of 2 inches back from all exposed surfaces.

When caulking compound is used to seal a joint containing premolded bituminous joint filler, a layer of an approved type of pressure-sensitive release tape shall be placed between these materials due to their incompatibility.

**D. Waterstops.** Waterstops shall be installed in joints to provide for expansion and contraction movements at joints. Place waterstop at all joints exposed to view, as shown in the contract documents, or as ordered by the Engineer. Waterstop shall be a polyvinyl chloride or other approved flexible material, copper strip, zinc strip or lead sheet. The waterstop shall extend at least 3 inches into the concrete on each side of the joint, shall be joined to be continuous and watertight, and shall be carefully protected from damage until covered by concrete or backfill.

### **555-3.07 Finishing.**

**A. General.** All exposed unformed surfaces, whether permanent or at construction joints, shall be finished by placing an excess of material in the forms and striking off the excess with a suitable float, forcing the coarse aggregate below the level of the finished surface, and troweled to a suitable finish. The use of mortar topping for surfaces shall not be permitted.

Following the discontinuance of placing concrete, all accumulation of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the plastic concrete.

**B. Bearing Surfaces.** The entire surface area of bridge seats or pedestals shall be floated and troweled to true grade or, at the option of the Contractor, left approximately 1/4 inch high and bush hammered or otherwise finished to the exact elevations indicated in the contract documents.

### **555-3.08 Curing.**

**A. General.** All structural concrete shall be cured for a minimum of seven curing days unless otherwise stated. The curing period shall begin only after all curing procedures and practices for a given placement are established. A curing day is defined as any day during which the ambient air temperature at the concrete surface is 45°F or higher for the entire day.

Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F. An aggregation of 24 curing hours will be credited as one curing day. Aggregations of less than 24 curing hours will not be credited.



Curing hours will be determined with continuous recording thermometers. The number and placement of the thermometers will be determined by the Engineer. Thermometers used to monitor curing temperatures shall consist of the following types:

**1. Continuously Recording Thermometer.** The thermometer shall be capable of continuously recording temperatures within a range of 0°F to 120°F for a minimum of 24 hours.

**2. Maximum - Minimum Recording Thermometer.** For all placements, the thermometer shall be capable of recording maximum and minimum temperatures within a range of 0°F to 120°F.

Provide all equipment, supplies, and labor necessary for calibration.

The curing temperature of concrete is the air temperature at the concrete surface, or the air temperature between the concrete surface and its protective covering. Temperatures at these locations are critical for proper concrete curing. For the purposes of this section the temperatures at the foregoing locations shall be maintained between 45°F and 85°F inclusive.

All structural concrete surfaces must be cured by any one, or a combination of, the following methods unless otherwise noted:

- Polyethylene curing covers - white opaque.
- Plastic coated fiber blankets.
- Clear (fugitive dye) membrane curing compound.
- Continuous burlap wetting.
- Wet burlap and curing covers.
- Forms left in place

Curing shall commence on all exposed surfaces no later than 30 minutes after completion of finishing. Finishing and curing operations shall progress with concrete placement.

Curing covers shall be placed as soon after concrete finishing as the Engineer determines will not cause damage to the concrete surface. However, under no circumstances shall the curing be delayed beyond 30 minutes of the completion of finishing. Care shall be taken so as not to damage the finished surface or texturing. Curing covers shall be lapped a minimum of 1 foot. All lapped edges shall be sealed with pressure sensitive tape. Covers shall be protected from displacement.

Clear (fugitive dye) membrane curing compound shall be sprayed on the concrete surface immediately following the finishing operation, or form removal, whichever is applicable. The compound shall be applied by means of a pressure spraying system, or by distributing equipment, at a minimum rate of 150 sf per gallon of surface. The equipment for applying the compound shall be such that the compound is applied as a fine spray with no surface damage to the concrete. The equipment shall also provide for adequate agitation of the compound during application, and shall be approved by the Engineer before work is started. Should the application method produce a nonuniform film, or should the spraying equipment fail and back-up equipment is not immediately available, the application shall cease. Curing shall then be continued by another acceptable method. The Contractor shall provide sufficient approved covers for protection of the concrete surface in the event of rain or equipment breakdown.

If forms are removed during the curing period (refer to §555-3.09), the concrete curing shall be continued using a clear (fugitive dye) membrane curing compound applied immediately after form removal.

**B. Provisions for Curing in Hot Weather.** When forms are left in place in extremely hot weather the forms shall require wetting to reduce surface heat.

If the ambient air temperature exceeds 85°F, continuous, uniform wetting for curing shall be required until the seven (7) day curing period is complete and forms are removed. Use of plastic sheeting over the established curing is not allowed in hot weather conditions.

**C. Provisions for Curing in Cold Weather.** If the ambient air temperature falls, or is expected to fall below 45°F, the requirements of Table 555-2 shall apply.

<b>TABLE 555-2 COLD WEATHER CURING REQUIREMENTS</b>	
<b>Ambient Temperature (AT) at time of concrete placement and as anticipated during curing duration</b>	<b>Curing requirements</b>
32°F < AT < 45°F for less than 24 consecutive hours	Contractor proposed/Engineer approved method for maintaining temperatures used
32°F < AT < 45°F for more than 24 consecutive hours	Heated enclosure required
AT < 32°F	Heated enclosure required

Prior to use, all proposed methods must meet the approval of the Engineer. If the curing temperature falls below 32°F at any time during the curing period, the concrete will be rejected.

To provide assurance of the curing temperatures, the Contractor shall supply thermometers meeting the requirements of §555.3.08A. Temperature measurements will be taken by the Engineer and a record will be maintained for the curing period. As a minimum, thermometers shall be placed adjacent to forms at the bottom, middle, and top of a placement. Additional thermometers may be placed in areas where extreme cold or heat, from external sources, can be expected.

If the existing method employed by the Contractor to maintain the curing temperature fails, the Contractor shall modify the existing method immediately to reestablish an acceptable curing temperature.

The length of the curing period will be extended until the required number of curing days are accumulated.

- 1. General.** When approval is granted in writing by the Engineer for cold-weather concreting, the curing temperature shall be maintained between 45°F and 85°F for the curing durations stated by provision of external heat or utilization of heat of hydration retained by insulated forms. Only when temperatures are maintained between 45°F and 85°F will the time be considered acceptable curing hours.
- 2. Provision of External Heat.** If the Contractor is required, or elects, to maintain curing temperatures by this method, the Contractor shall furnish sufficient canvas and framework, or other type of housing, to enclose and protect the structure. The enclosure and heat source(s) shall be established in such a way that the air surrounding the fresh concrete, on all sides, be kept at a temperature between 45°F and 85°F for the specified curing period. At the end of the curing period, the heat shall be gradually reduced at a rate not to exceed 1 degree F per hour until the temperature within the enclosure equals the temperature outside the enclosure. Materials and equipment necessary to erect the enclosure and provide external heat shall be present on the job site and approved by the Engineer before any concrete is placed.

External heat shall be provided by means of stoves, salamanders, heated hoses, steam equipment, warmed curing water, or other equipment supplied by, operated by the Contractor. Heating appliances shall not be placed in such a manner as to endanger formwork, centering, or expose any area of concrete to drying out or damage due to excessive temperatures. Sufficient equipment shall be supplied to continuously maintain the specified temperature with a reasonable degree of uniformity in all parts of the enclosure. The enclosures shall be properly vented to prevent surface disintegration of fresh concrete due to

an accumulation of carbon dioxide gas. All exposed concrete surfaces within the heated area shall be protected from drying by one of the following methods:

- Use of live steam.
- Continuous wet burlap or wet burlap used with curing covers.
- Curing compounds used with curing covers.

<b>TABLE 555-3 INSULATION REQUIREMENTS FOR CONCRETE WALLS, PIERS AND ABUTMENTS ABOVE GROUND</b>				
Wall Thickness (Inches)	Minimum ambient air temperatures (°F) allowable for concrete placed at 50°F (Thermal Resistance Values (R): hr·ft <sup>2</sup> ·F/Btu )			
	R = 2	R = 4	R = 6	R = 8
Portland Cement Content: 400 lb/cy				
6	47	44	40	36
12	43	35	26	17
18	39	25	11	-2
24	34	16	-2	-20
36	25	-1	-27	-53
48	18	-10	-38	*
60	18	-10	-38	*
Portland Cement Content: 500 lb/cy				
6	47	43	38	33
12	42	31	20	9
18	36	19	2	-15
24	30	7	-16	-39
36	18	-15	-46	-79
48	10	-25	-60	*
60	10	-25	*	*
Portland Cement Content: 600 lb/cy				
6	46	41	35	29
12	40	28	14	0
18	33	13	-7	-29
24	26	-1	-28	-55
36	12	-27	-66	*
48	4	-40	*	*
60	4	-40	*	*
Portland Cement Content: 700 lb/cy				
6	45	39	32	25
12	38	24	8	-8
18	30	7	-16	-42
24	22	-9	-41	-74
36	5	-40	-85	*
48	-4	-54	*	*
60	-4	-54	*	*
Portland Cement Content: 800 lb/cy				

6	45	38	30	22
12	37	20	2	-16
18	28	1	-26	-55
24	18	-18	-54	-91
36	-2	-54	*	*
48	-11	-68	*	*
60	-11	-68	*	*

\* < - 60 °F

When using concrete containing pozzolans, do not consider the pozzolans as part of the cement content. Use values given for a Portland cement content that are equal to or less than the actual cement content of the mix, due to a lower heat of hydration when using pozzolans.

- 3. Heat Retention by Insulated Forms.** Insulated forms may be used to maintain acceptable curing temperatures in accordance with the provisions of Table 555-2, when ambient temperatures will not drop below 32°F. If the Contractor elects to maintain curing temperatures by this method, sufficient insulation shall be furnished to protect and maintain the temperature between the insulation and formwork within the range of 45°F to 85°F for the specified curing period.

Discontinuance of protection shall be accomplished in such a manner that the drop in temperature of any portion of the concrete shall be gradual. The surface temperature of concrete sections more than 2 feet in thickness shall not drop faster than 18°F in a 24-hour period. The surface temperature of concrete sections less than 2 feet in thickness shall not drop faster than 36°F in a 24 hour period.

Forms may be removed without restriction, providing the temperature difference between the air and the surface of the concrete is not more than 30°F. If possible, forms shall be removed about the middle of the day to take advantage of the generally higher afternoon temperatures.

Form insulating material shall be installed on the forms in such a manner so as to achieve the full benefit of its insulating properties and at the same time provide against the infiltration of wind and water. All portions of steel forms shall be covered by insulating material so that no steel is exposed to the air. Any tears or damaged areas in the insulating material shall be repaired. Special attention shall be given to ensure that all corners and angles are properly insulated and protected against wind damage.

Where tie rods extend through the form insulating material, a plywood washer (¾ x 6 x 6 inches approx.) shall be placed over the tie rod and secured against the insulating material.

After placement of the concrete, the exposed concrete surfaces shall be covered with insulating blankets, except for areas where protruding reinforcing bars make the use of blankets impracticable. These areas may be covered with hay or other acceptable insulating material. Tarpaulins shall be used to protect the insulating material.

Insulating material shall be insulating blankets, solid foam, or sprayed foam meeting the requirements of §711-07, Form Insulating Materials for Cold Weather Concreting. The appropriate R value of material shall be used to insulate the concrete according to Table 555-3.

Multiple layers of insulation may be used to attain the desired level of insulation (R value), to maintain the required curing temperatures. Extra care shall be taken in insulating edges and corners where additional layers or overlaps are required.

**TABLE 555-4 MINIMUM TIME FOR FORM REMOVAL/FORMING/LOADING LIMITATIONS –SUBSTRUCTURES <sup>(1)</sup>**

SUBSTRUCTURE ELEMENT	STRIPPING <sup>(2)</sup>	FORMING NEXT PLACEMENT	LOADING
All Footings	2 days	2 days	4 days before next placement
Abutment stems, backwalls	2 days if less than 10 feet (avg.). Add 1 day for each additional 5 feet to 5 days, maximum.	2 days	5 days before placing backwall on stem. 7 days before backfilling, 14 days before placing superstructure loads. <sup>(3)</sup>
Pier Columns, Pier Plinths	2 days if less than 10 feet high (avg.). Add 1 day for each additional 5 feet.	4 days – columns 2 days if forming pedestal	Columns – 7 days before placing cap beam. Plinth- 2 days before pedestal placement. 21 days before placing superstructure loads. <sup>(3)</sup>
Pier cap beams	8 days (bottom) 3 days (sides)	2 days	5 days before pedestal placement. 21 days before placing superstructure loads. <sup>(3)</sup>
All pedestals	2 days	—	7 days (class A) 3 days (class F) <sup>(4)</sup>
Wingwalls or Retaining walls	Same as abutment stems.	—	14 days before backfilling <sup>(3)</sup>
Arch centers Centering under beams	8 days	—	14 day <sup>(3)</sup>

**Notes:**

1 The minimum times for loading in this table are NOT applicable when using concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when ambient temperatures are 60°F or less. The provisions in Note 3 are required for casting, curing, and testing of compressive strength cylinders for concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when the ambient temperature is 60°F or less. The compressive strength results will be the basis of determining when loading can occur.

2 All concrete shall be cured for a minimum of seven curing days. A “Day” is a curing day as defined in Subsection 555-3.08A. Concrete surfaces being cured using forms, covers, or blankets from which the covers are removed for any purpose prior to the full cure period shall be sprayed with an approved clear (fugitive dye) curing compound within ten minutes of cover removal.

3 When early loading is requested, the minimum time requirements for loading may be reduced (or extended) based on test cylinder compressive strength results. The DCES will establish requirements for early loading upon request. The Contractor shall notify the Engineer, in writing, at least 10 days prior to placement, that early loading is being requested, so that arrangements for test cylinders can be made. Test cylinders shall be prepared in accordance with Materials Method 9.2 – Field Inspection of Portland Cement Concrete. Two test cylinders shall be prepared for each anticipated testing period. These cylinders shall be cured in the same manner as the substructure element which they represent. After the first compression test, the Engineer shall determine subsequent testing periods based on the results of the first test. No more than three tests for each substructure element shall be allowed.

4 Minimum time for loading pedestals shall not compromise minimum loading times specified for other placements.

**555-3.09 Form Removal.** Forms shall be removed in such a way as to permit the concrete to take the stresses uniformly and gradually. Any method of form removal likely to cause overstressing of the concrete shall not be used.

The forms for any portion of a structure shall not be removed until the concrete is strong enough to resist damage. The earliest time of form removal shall be as specified in Table 555-4, Minimum Time for Form Removal - Substructures. If the form removal causes damage, the operation must stop immediately

until such time that sufficient concrete strength is achieved. All damage shall be repaired in conformance with §555-3.13, Damaged or Defective Concrete.

**555-3.10 Loading Limitations.** Forms used for substructure concrete placements shall be removed in accordance with the requirements of Table 555-4, Minimum Time for Form Removal - Substructures. The minimum times for loading in this table are NOT applicable when using concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when ambient temperatures are 60°F or less. The provisions in Note 3 are required for casting, curing, and testing of compressive strength cylinders for concrete that contains fly ash or ground granulated blast furnace slag that is placed and/or cured when the ambient temperature is 60°F or less. The compressive strength results will be the basis of determining when loading can occur.

**555-3.11 Corrective Finishing.** Immediately after forms have been removed, surfaces exposed to view shall have all projections and irregularities carefully removed and all cavities greater than 1 inch in diameter and/or 1/4 inch in depth neatly filled with mortar of the proportion used in the concrete. The same brand of cement and the same kind of aggregate shall be used for filling cavities as was used in the original concrete mix. Plastering of surfaces shall not be allowed. The surface film (drying cement paste) of all such repaired surfaces shall be carefully removed before setting occurs.

All rust and other stains shall be removed from concrete exposed to view. Removal shall be accomplished using methods and materials approved by the Engineer. Materials used for rust stain removal shall be as listed on the Approved List published by the Department's Materials Bureau.

**555-3.12 Weep Holes.** The Contractor shall construct weep holes in all retaining walls and abutments as indicated in the contract documents.

**555-3.13 Damaged or Defective Concrete.** All defects or damage to concrete which occurs prior to the final acceptance of the work shall be repaired or replaced at no additional expense to the State. The defects shall include but are not limited to spalling and irregular cracking at joints, edge spalls, honeycombing, and damage or other imperfections caused by traffic and/or construction operations. Any concrete requiring complete replacement shall be replaced in kind as concrete originally called for in the contract documents. Any repairs shall be performed to the methods described in these specifications unless otherwise approved by the Engineer. When a repair is made, the defective or damaged concrete shall be removed by saw cutting the perimeter to a depth of 1 1/2 inches, chipping the unsuitable material to sound concrete with light, hand held, pneumatic tools at a 45 degree angle into the patch area, and cleaning all exposed reinforcing and concrete surfaces. All surfaces to be repaired shall be thoroughly blast cleaned. Prior to placing repair concrete, all surfaces shall be wetted to a saturated surface dry condition.

Small spalls of 0.1 cy or less, and areas of 10 sf or less where concrete removal is required may be repaired using approved Concrete repair materials. Vertical or overhead surfaces may be patched with Vertical and Overhead Patching Material. Surface preparation for small repairs shall be according to the material manufacturer's recommendations. After repair is complete, and curing time has elapsed, the Engineer will hammer sound all repair areas to assure proper bond has been achieved.

Concrete with surfaces misshapen by bulges or deformations caused by inadequate forms, or resulting in insufficient cover of reinforcing, shall be removed or corrected.

## **555-4 METHOD OF MEASUREMENT**

**555-4.01 Concrete for Structures.** The work will be measured for payment as the number of cubic yards of concrete for structures satisfactorily placed, measured to the nearest 0.1 cubic yard within the lines of the structure as shown in the contract documents. No deductions shall be made for the volume of

joint material, embedded metal reinforcement, structural shapes, chamfers, tops of piles, or pipe with an end area of less than 1 sf.

## 555-5 BASIS OF PAYMENT

**555-5.01 General.** When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete using the originally specified method of measurement.

**555-5.02 Concrete for Structures.** The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except reinforcement will be paid for separately under its appropriate item. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing flashing or other metal strips, flexible water stops, sheet packing, pipe drains, bituminous material, water for wetting, joint materials, felt, tar paper, joint sealing compounds, joint fillers, and concrete curing materials.

No extra compensation for falsework or falsework piling will be paid. This work is included as part of the formwork.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Bridge bearings, expansion joints, and anchor bolts will be paid for under their appropriate items.

Progress payments will be made, after the concrete and curing applications have been properly placed, to the extent that payment will be made at 90% of the computed quantity of each concrete placement, with the balance to be paid after completion of all curing and corrective work thereon.

### *Payment will be made under:*

Item No	Item	Pay Unit
555.0104	Footing Concrete, Class A (No Concrete Class Substitutions Permitted, Except Class H Where Footing is 3 feet Thick or Less)	Cubic Yard
555.0105	Concrete for Structures, Class A	Cubic Yard
555.05	Concrete for Structures, Class F	Cubic Yard
555.06	Concrete for Structures, Class G (Deposited Under Water)	Cubic Yard
555.07	Concrete for Structures, Class GG (Deposited Under Water)	Cubic Yard
555.08	Footing Concrete, Class HP	Cubic Yard
555.09	Concrete for Structures, Class HP	Cubic Yard
555.10	Concrete for Structures, Class D	Cubic Yard
555.11	Concrete for Structures, Class DP	Cubic Yard

## SECTION 556 - REINFORCING STEEL FOR CONCRETE STRUCTURES

**556-1 DESCRIPTION.** The work will consist of furnishing and placing reinforcing steel for concrete structures, or stud shear connectors, in accordance with the contract documents, and in a manner satisfactory to the Engineer.

Reinforcing steel for concrete structures may be uncoated, epoxy-coated, galvanized, or stainless steel, as indicated in the contract documents.

**556-2 MATERIALS.** Materials for this work shall meet the requirements of the following subsections of Section 700-Materials and Manufacturing:

Uncoated Bar Reinforcement, Grade 60	709-01
Wire Fabric for Concrete Reinforcement	709-02
Epoxy-Coated Bar Reinforcement	709-04

Stud Shear Connectors	709-05
Epoxy-Coated Wire Fabric Reinforcement	709-08
Mechanical Connectors for Reinforcing Bar Splices	709-10
Galvanized Bar Reinforcement	709-11
Stainless Steel Bar Reinforcement	709-13
Uncoated Bar Reinforcement, Grade 75	709-14
Grouted Reinforcing Bar Splice Sleeves	709-15

**556-2.01 Devices for Supporting and Tying Reinforcement.** Chairs, tie wires, and other devices used to support, position, or fasten the reinforcement shall be made of or coated with, a dielectric (electrically insulating) material. Stainless steel chairs without polyethylene tips and meeting the requirements of ASTM A493, AISI Type 430, may also be used. The specific hardware that the Contractor proposes to use shall be approved by the Engineer.

When forms are to be removed in their entirety, uncoated steel chairs equipped with snug-fitting, high-density, polyethylene tips which provide 1/4 inch clearance between the metal and any exposed surface may be used, except that uncoated steel chairs shall not be used in contact with stainless steel.

### 556-3 CONSTRUCTION DETAILS

#### 556-3.01 General

**A. Ordering.** Prior to ordering reinforcing steel, the Contractor shall carefully check all bar lists, and assume full responsibility for their accuracy. No change in the bar list shall be made by the Contractor unless approved by the DCES. If no bar list is provided in the Plans, then §557-3.17 No Bar List Provided shall apply.

#### B. Handling and Storage

**1. Epoxy-Coated Reinforcing Steel.** All epoxy-coated reinforcement shall be stored above ground on wood or padded supports.

Epoxy-coated reinforcement stored on-site shall be protected from sunlight and moisture using opaque waterproof covers. Covers shall be placed in a manner that will permit constant air circulation so as to minimize the formation of condensation on the epoxy-coated surface.

All equipment for handling epoxy-coated steel shall have padded contact areas. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports, or a platform bridge so as to prevent steel-to-steel abrasion from sags in the bundle.

Steel shall not be dropped or dragged. Care shall be taken at all times to prevent damage to the epoxy coating.

Steel that is partially embedded in concrete shall have the exposed sections protected with opaque waterproof covers prior to any winter shutdown of a project.

**2. Galvanized Bar Reinforcement.** All galvanized bar reinforcement shall be stored above ground on wood or padded supports and arranged so that rainwater drains off the bars.

**3. Stainless Steel Bar Reinforcement.** Stainless Steel Bar Reinforcement shall be stored separately and shall be handled using tools that are not used on carbon steel.

**C. Placing and Fastening Reinforcing Steel.** Prior to placing reinforcement, all grease, dirt, mortar, and any other foreign substances shall be removed.

Loose rust and loose millscale on uncoated reinforcement shall be removed by wire brushing.

Steel reinforcement shall be placed in the position indicated in the contract documents and within the



allowable tolerances specified. Before concrete is placed, all reinforcement shall be securely fastened and supported with approved chairs or other approved devices.

**D. Inspection.** Concrete shall not be placed until the reinforcing steel is inspected, placement of the steel meets applicable tolerances, and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision will be rejected and removed.

### **556-3.02 Steel Fabric Reinforcement.**

**A. Field Repair of Coatings.** Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 1/4 x 1/4 inch. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per foot of wire.

Reinforcing fabric having coating damage exceeding the above criteria shall be rejected and immediately removed from the work site.

**B. Placement.** Steel fabric reinforcement shall be placed as shown in the contract documents. Unless otherwise noted in the contract documents, steel fabric reinforcement shall be overlapped a minimum of the distance between adjacent wires in the panel. Overlapping panels of steel fabric reinforcement shall be wired together to ensure that the location and overlap of the mesh panels is maintained during concrete placement.

### **556-3.03 Bar Reinforcement**

**A. Field-Bending.** The bar reinforcement shall be bent to the shapes shown in the contract documents. Unless shown otherwise in the contract documents or below, the radii of bends, measured to the inside face of the bend, shall be greater than, or equal to, three times the diameter of the bar. Bends in stirrups shall be greater than, or equal to, the diameter of the bar.

**1. Uncoated Bar Reinforcement.** When bars are heated for field-bending they shall not be heated to a temperature higher than that producing a dark cherry-red color. Only competent personnel shall be employed and proper equipment provided for cutting and bending.

**2. Epoxy - Coated Bar Reinforcement.** The alternatives of shop bending or field-bending of epoxy-coated bar reinforcement will be at the option of the Contractor. Field-bending shall be done by cold methods only.

Field-bending operations will be allowed only when ambient and bar temperatures are 40°F or greater. When lower temperatures prevail, the Contractor may supply, for field-bending operations, a fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

Epoxy coatings damaged by field-bending work shall be evaluated and repaired or replaced, in accordance with the requirements of §556-3.03 B.1 Epoxy-Coated Bar Reinforcement.

**3. Galvanized Bar Reinforcement.** The galvanized bar reinforcement shall be shop bent before galvanizing. Up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only. When bending galvanized bar reinforcement size 7 and greater, the minimum bend radius measured to the inside face of the bend shall be increased to 4.5 times the bar diameter. For bars numbered 14 and 18, increase the bend radius to 5.5 times the bar diameter.

Field-bending operations will be allowed only when ambient and bar temperatures are 40°F or greater. When lower temperatures prevail the Contractor may supply, for field-bending operations, a fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

The ends of bars cut after galvanizing shall be coated with zinc repair material following the

procedures of §719-01, Galvanized Coatings and Repair Methods except that repair materials containing aluminum shall not be permitted.

Galvanizing damaged by field-bending work shall be evaluated and repaired, or replaced, in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

**4. *Stainless Steel Bar Reinforcement.*** The stainless steel bar reinforcement shall be shop bent or field bent as shown in the contract documents. When shop bending is required, up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only.

## **B. *Field Repair of Coatings***

**1. *Epoxy-Coated Bar Reinforcement.*** The Contractor will be required to field repair damaged areas of the bar coating, and to replace bars exhibiting severely damaged coatings. The material used for field repair shall be that supplied by the coating applicator.

Field repair will be required on all areas of major damage. Major damage is defined as any defect or break in the epoxy coating 1/4 x 1/4 inch or greater. The total number of all major damaged areas which have been repaired with patching material shall not exceed five (5) in any 10 foot length of bar.

Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 1/4 x 1/4 inch. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per foot on any individual bar.

A reinforcing bar having coating damage determined by the Engineer to exceed the above criteria shall be rejected and immediately removed from the work site. All such bars shall be replaced, in kind, by the Contractor at no additional cost to the State.

**2. *Galvanized Bar Reinforcement.*** The Contractor shall field repair damaged areas of the bar coating, and replace bars exhibiting severely damaged coatings. Severe damage is defined as more than five (5) 1/4 x 1/4 inch or larger areas in a 10 foot length. The material and procedures used for field repair shall meet the requirements of §719-01, Galvanized Coatings and Repair Methods, except that repair materials containing aluminum shall not be permitted.

**C. *Splices.*** Splices will be permitted only where shown in the contract documents. Should the Contractor desire to splice bars at locations other than those shown in the contract documents, written permission to do so shall first be obtained from the DCES. Such permitted splices shall be well distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum of 2 inches can be provided between the splice and the nearest adjacent bar.

Splices for bar sizes No. 11 or smaller, shall be made by means of a mechanical connector or by placing the bars in contact and wiring them together for the full length of the splice. Splices for bars larger than No. 11 shall be made by use of a mechanical connector unless welding is specifically required by the contract documents. Mechanical connectors shall be installed in accordance with the manufacturer's written requirements. Mechanical connectors for stainless steel shall be stainless. Welding stainless steel will not be permitted unless the proposed welding technique is submitted to and approved by the DCES.

Arc-welded splices shall be made and will be inspected in accordance with the provisions of the SCM.

Prior to welding of epoxy-coated reinforcing bars, the epoxy coating shall be removed for the length to be welded plus 6 inches on each side of the weld. After welding, the spliced area shall be cleaned in accordance with SSPC - Surface Preparation Specification No. 6 (SSPC-SP6), Commercial Blast Cleaning. The surface shall be blast cleaned to SSPC-SP6 Commercial Blast Cleaning standard.

Photographs in SSPC-VIS 1, Guide And Reference Photographs for Steel Surfaces Prepared by

Dry Abrasive Blast Cleaning, for B SP6, C SP6, D SP6, G1 SP6, G2 SP6, or G3 SP6, can be used as a guide to identify the desired cleaning, depending on the initial condition of the steel. However, the written standard for SP6 will be the primary means to determine conformance with blast-cleaning requirements. The photographs shall not be used as a substitute for the written standards. A compatible epoxy repair material supplied by the coating applicator shall be applied to the spliced area and overlap the original coating by 6 inches. The epoxy repair material shall be applied the same day as the cleaning.

Prior to welding galvanized bar reinforcement, the zinc coating shall be removed for the length of the weld plus 2 inches on each side of the weld. Cleaning shall be the same criteria as for epoxy-coated reinforcing. Coating repair shall be in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

**D. Placement in Structural Slabs.** Bar supports shall be spaced no farther apart than 4 feet center-to-center, nor shall any bar support be closer than 6 inches from the edge of any future concrete surface. Bridge slab bar reinforcement shall be placed in accordance with the following tolerances:

Vertical  $\pm 1/4$  inch

Horizontal  $\pm 1/2$  inch

The structural slab bar reinforcement mats (top and bottom) shall be securely connected together. This connection shall be accomplished by wiring or other means approved by the Engineer. Connections shall be placed no farther apart than 4 feet on center. The bar supports may be utilized for this purpose. Connecting devices shall neither deflect the bar reinforcement nor interfere with the smooth flow of concrete. Stainless steel reinforcement shall not be in direct contact with uncoated steel reinforcement, nor with galvanized reinforcement. This does not apply to stainless steel wires and ties.

Immediately prior to placement of concrete, the Engineer will verify that the reinforcing steel is positioned within the above-stated tolerances.

Subsequent to placement of concrete, the Engineer will verify, at random, that the vertical clear distance from the top of the structural slab to the top mat of main reinforcing, as shown in the contract documents, is correct within a tolerance of plus or minus 1/2 inch. If the allowable tolerance is exceeded, the Engineer will reject the work and so advise the Contractor and the DCES, in writing, stating the deficiencies upon which the rejection is based. The DCES will review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:

1. The affected concrete placement shall be removed and replaced in whole or in part.
2. The Contractor shall provide special corrective measures as directed by the DCES.
3. The concrete placement shall be accepted without corrective action.

**556-3.04 Stud Shear Connectors for Bridges.** Stud shear connectors shall be shop or field welded to the structural steel members at the locations indicated in the contract documents. This work shall be done in accordance with the provisions of the SCM.

#### **556-4 METHOD OF MEASUREMENT**

**556-4.01 Steel Fabric Reinforcement.** The quantity of steel fabric reinforcement satisfactorily installed will be measured for payment as the number of square yards of overall surface area of the deck or structure shown on the contract documents, not including clear distance to the edges, measured to the nearest whole square yard. No subtractions will be made for holes smaller than one-half of a square yard, and no additional payment will be made for overlaps.

**556-4.02 Bar Reinforcement.** These will be measured as the number of pounds of steel bars placed. The weight of bar reinforcing will be computed by the Engineer utilizing the unit mass for each size bar as

given in Table 556-1. No allowance will be made for the weight of any coating on the bars.

<b>TABLE 556-1 UNIT WEIGHT OF DEFORMED BARS</b>											
<b>Bar Number</b>	3	4	5	6	7	8	9	10	11	14	18
<b>Weight (lb/ft)</b>	0.376	0.668	1.043	1.502	2.044	2.670	3.400	4.303	5.313	7.650	13.60

**NOTE.** Bar Numbers are bar sizes in numbers of eighths of an inch.

**556-4.03 Stud Shear Connectors for Bridges.** Stud Shear Connectors will be measured as each connector placed.

**556-5 BASIS OF PAYMENT**

**556-5.01 Steel Fabric Reinforcement.** The unit price bid per square yard will include the cost of all labor, materials, and equipment necessary to complete the work. The removal of the concrete placement and its subsequent replacement, or other corrective work which the Contractor is directed to perform, shall be accomplished at no additional cost to the State. No additional payment will be made for the replacement of defective fabric or the replacement of fabric with defective coatings.

**556-5.02 Bar Reinforcement.** The unit price bid per pound shall include the cost of all labor, materials, and equipment necessary to complete the work. The unit price shall also include the cost of chairs, supports, fastenings, connections, and splices not specifically shown in the contract documents. If the Engineer permits the substitution of larger bars than those specified, or the DCES permits splices not shown in the contract documents, payment will be made only for the amount of steel which would have been required if the specified size and length had been used. No additional payment will be made for enclosures constructed for bending of bars or for replacement of defective bars or for replacement of bars with defective coatings.

**556-5.03 Stud Shear Connectors for Bridges.** The unit price bid per stud shall include the cost of all labor, materials, and equipment necessary to complete the work. If the use of any stud shear connector requires payment of a royalty to the manufacturer, the royalty shall be included in the unit price bid for this work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
556.0101	Uncoated Steel Fabric Reinforcement for Structures	Square Yard
556.0102	Epoxy-Coated Steel Fabric Reinforcement	Square Yard
556.0201	Uncoated Bar Reinforcement for Concrete Structures	Pound
556.0202	Epoxy-Coated Bar Reinforcement for Structures	Pound
556.0203	Galvanized Bar Reinforcement for Structures	Pound
556.0205	Stainless Steel Bar Reinforcement for Structures	Pound
556.03	Stud Shear Connectors for Bridges	Each

**SECTION 557 - SUPERSTRUCTURE SLABS, SIDEWALKS ON BRIDGES, AND STRUCTURAL APPROACH SLABS**

(Last Revised September, 2020)

**557-1 DESCRIPTION.** The work shall consist of placing high performance (Class HP) concrete to construct superstructure slabs, sidewalks, safety walks, and structural approach slabs, as required by the contract documents.

## **557-2 MATERIALS**

**557-2.01 General.** The materials used for superstructure slabs, sidewalks on bridges, and structural approach slabs shall meet the material requirements of the following subsections:

Structural concrete materials	555-2.01
Reinforcing steel	556-2
Prestressed concrete form units	718-05
Permanent Corrugated Metal Forms for Bridge Slabs	736-01

**557-2.02 Concrete.** This shall meet the material requirements for Class HP in accordance with §501. Unless otherwise directed by the Engineer, all concrete shall contain a water-reducing and retarding admixture, meeting the requirements of §711-08. The quantity of the admixture shall be sufficient to achieve the minimum retardation consistent with placing conditions to keep the entire placement plastic (either one continuous placement or all sections of a sequence placement). The dosage rate used shall be determined by the Contractor in accordance with the manufacturer's recommendation and in concurrence with the Regional Materials Engineer. The dosage shall remain consistent for the duration of the concrete placement except for minor adjustments to meet changing environmental conditions.

**557-2.03 HPIC Concrete** This shall meet the requirements of **557-2.02 HP Concrete** with the following modifications:

1. The maximum w/c ratio is 0.40. Do not include absorbed moisture of the light weight fine aggregate as part of the w/c ratio calculation.
2. Substitute lightweight fine aggregate, meeting the requirements of AASHTO M 195, for 30% (by volume) of standard fine aggregate.

The Regional Materials Engineer, or his representative, will approve the batch weights prior to use. Use these values to manufacture all internally cured high performance concrete and periodically correct the batch weights to account for changes in the fine aggregate fineness modulus and aggregate moisture contents.

## **557-3 CONSTRUCTION DETAILS**

**557-3.01 Concrete Manufacturing and Transportation.** The requirements of §501-3 shall apply.

A. For HPIC additional requirements follow:

1. Construct lightweight fine aggregate stockpile(s) at the production facility so as to maintain uniform moisture throughout the pile. Using a sprinkler system approved by the Materials Engineer. Continuously and uniformly sprinkle the stockpile(s) with water for a minimum of 48 hours, or until the "Absorbed Moisture content" of the aggregate in the stockpile is at least 15% by weight as determined by Test Method NY 703-19E (<https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>). If a steady rain of comparable intensity occurs, turn off the sprinkler system at the direction of the Materials Engineer, until the rain ceases. At the end of the wetting period, or after the rain ceases, allow stockpiles to drain for 12 to 15 hours immediately prior to use,

unless otherwise directed by the Materials Engineer.

2. The moisture content of the lightweight fine aggregate must be determined immediately prior to batching, using Test Method NY 703-19E. If the supplied mix design is based on “oven dry” weight of lightweight fine aggregate, a corresponding adjusted weight must be supplied to account for the actual absorbed moisture content, so that the mix design entered in to the automated batching system is based on SSD weight. After the adjusted mix design is entered into batching system, additional adjustments must be made to the fine aggregate and water quantities to account for the “surface” moisture of the fine aggregates.
3. The lightweight fine aggregate, at the time of batching must be at least 15% absorbed moisture content. Batch the lightweight fine aggregate first, then routinely batch the fine aggregate, coarse aggregate, admixtures, cement, pozzolan, Microsilica, and remaining mixing water and mix completely.

**557-3.02 Falsework.** The requirements of §555-3.02 shall apply.

**557-3.03 Forms.** Unless otherwise noted the contractor may use any of the following forming systems to form the underside of the superstructure slabs:

**A. Removable Forms.** The requirements of §555-3.03A shall apply.

**B. Permanent Corrugated Metal Forms for Superstructure Slabs.** Where permanent metal forms are employed, the following construction procedures shall apply.

Care and protection shall be given the metal form sheets, supports, and accessory items during handling, shipping, and storage. During loading, hoisting, and unloading operations, extra precaution and care shall be taken to prevent damage to ends, corners, and edges of the form sheets, supports, and accessory items. If the form units and accessories are to be stored prior to installation, they shall not be placed in contact with the ground and the material shall be adequately covered or protected to keep it dry.

Form supports shall be placed in direct contact with the flange of a stringer or floor beam. All attachments shall be made by permissible welds, bolts, clips, or other approved means. The welding of form supports to steel not considered weldable or to portions of flanges subject to tensile stresses shall not be permitted. Welding shall be in accordance with the provisions of the New York State Steel Construction Manual (SCM) except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a welder certified under the SCM.

Form sheets shall not be permitted to rest directly on the flanges. They shall be securely fastened to form supports by self-tapping screws and shall have a minimum bearing length of 1 inch at each end. Transverse construction joints shall be located at the bottom of a flute and 1/4 inch weep holes shall be field drilled at not less than 1 foot on centers along the line of the joint.

Screed rail and pouring runway supports shall not be located directly on the form sheets, form supports, or reinforcing steel. No loose sheets or miscellaneous hardware shall be left on the structural slab at the end of the work day. Metal forms shall not be used where longitudinal slab construction joints are located between stringers, nor shall they be used on the fascia overhang.

The corrugated metal sheets shall be fabricated for the placement sequence used with the joints between sections of sheet overlapped or securely fastened to eliminate differential deflections between sections. Any exposed form metal where galvanizing has been damaged, shall be cleaned and repaired as provided for in §719-01, Galvanized Coatings and Repair Methods.

**C. Prestressed Concrete Form Units.** The applicable requirements of §555-3.03A and the Prestressed Concrete Construction Manual shall apply.

Form supports shall be placed in direct contact with the flange of the stringer. All attachments shall be made by permissible welds, bolts, or other means approved by the Engineer. The welding of form supports to steel not considered weldable, or to portions of flanges subject to tensile stresses will not be permitted. Welds and welding shall be in accordance with those portions of the SCM concerned with fillet weld design, fillet weld details, general workmanship and technique, except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a welder certified under the SCM.

**D. Restrictions.** The following restrictions shall apply to all forms.

1. Fascia overhangs shall be formed with removable forms to provide a flat concrete surface.
2. A bay, constructed in stages such that a longitudinal joint is required, shall only be formed with removable forms.
3. A haunch which rests upon an end diaphragm shall only be formed with removable or permanent corrugated metal forms.
4. Prestressed concrete form units shall not be used where the design span is less than 5 feet nor greater than 11 feet. The design span is equal to the beam spacing minus one-half the top flange width.
5. Prestressed concrete form units may be restricted at the ends of some skewed spans. Refer to the contract documents for details.
6. Prestressed concrete form units shall not be used on prestressed concrete box beam superstructures unless specifically allowed by the contract documents.

**557-3.04 Placing and Fastening Reinforcing Steel.** Immediately prior to placement of concrete, the Engineer will verify that the reinforcing steel is positioned within required tolerances. If the allowable tolerances are exceeded, the Contractor shall correct the position of the reinforcing steel before placing concrete. All reinforcing steel and chairs shall be anchored to prevent uplift.

**A. Permanent Corrugated Metal Forms or Removable Forms.** Except for prestressed concrete form units the requirements of §556-3.01 and §556-3.03 shall apply.

**B. Prestressed Concrete Form Units.** The requirements of §556-3.01 and §556-3.03 shall apply. The top reinforcing steel mat shall be securely connected to the forms and the stud shear connectors. Connections shall be placed no farther apart than 4 feet on center. Connections to the forms may be made to the form-lifting devices, reinforcing steel projecting from the forms, or devices in the form supplied for this purpose. Hold-down devices shot into the form will not be permitted. Connections shall neither deflect the reinforcing steel nor interfere with the smooth flow of concrete.

**557-3.05 Handling and Placing Concrete.** The requirements of §555- 3.04 Handling and Placing Concrete shall apply. A Preplacement Meeting is required to be held at least one week prior to the start of any concrete placement for superstructure slabs. Meeting participants besides the Contractor and Engineer should include materials suppliers, subcontractors, Regional Materials Engineer, Regional Safety Officer, and others as deemed appropriate. Participants will review all aspects of the proposed placement including, but not limited to, the following:  
Equipment proposed for use and for backup.

- Planned workforce, assigned tasks of each designated position, and experience and expertise.
- Proposed construction techniques and crew experience.
- Safety considerations.
- Concrete mix design.

- Admixtures and technical data; dosage rates will be approved by the Regional Materials Engineer.
- Proposed placement rate, curing and loading schedules.
- Curing practices to be employed as well as the workforce designated to the curing process.
- Delivery/conveyance equipment, including deck finishing machine setup and operation.
- Traffic control.

For placements proposed between October 1<sup>st</sup> and April 1<sup>st</sup> the Preplacement Meeting should additionally review cold weather concreting operations including, but not limited to, the following:

- Expected environmental conditions at time of placement and during curing
- Proposed curing methods to maintain acceptable curing temperature

No concrete shall be placed until all aspects of the proposed placement are approved by the Engineer. A written report of the preplacement meeting will be established by the Engineer. Modifications shall be submitted in writing to the Engineer for approval. Further, for placements between October 1 and April 1st, no concrete shall be placed until all aspects of the proposed placement are approved by the Regional Construction Engineer.

Before concrete slabs are placed on steel spans, all permanent field connections shall be completed unless otherwise noted on the contract plans, and all temporary supports and mechanisms used in steel erection shall be removed.

No concrete shall be placed until all the provisions of §555-3.04A. Placement Limitations are met, environmental conditions are deemed favorable, and satisfactory means to mitigate adverse environmental conditions exist. Favorable environmental conditions are defined as an expected weather forecast suitable for concrete placement during the entire placement duration, the evaporation rate not to exceed 0.25 lb/sf-hr, and acceptable curing temperatures expected for the duration of the curing period.

The Contractor shall provide any necessary means to mitigate adverse weather conditions and curing temperatures. Failure to maintain acceptable environmental conditions will result in the concrete placement being stopped and a bulkhead put in place.

The Contractor shall take the necessary measurements and calculate the theoretical evaporation rate. The measurements for air temperature, relative humidity, and wind speed shall be taken as near as possible to the final placement location of the concrete.

Concrete temperature will be taken from the same sample used for slump and air content tests. These measurements will be taken prior to commencement of concrete placement. If, in the Engineer's opinion, significant changes occur in atmospheric conditions, additional atmospheric measurements and calculations by the Contractor will be required. The Contractor shall supply all instruments necessary to make the required calculations. All instruments shall be approved by the Engineer, as being in good working order. The Contractor's measurements and calculations will be subject to the Engineer's approval. To determine the evaporation rate, apply the values taken for relative humidity, plastic concrete temperature, air temperature, and wind velocity to Figure 557-1 Structural Concrete Evaporation Rate.

The placing of concrete for any bridge slab shall be continuous between joints. Conveyance of concrete shall meet the requirements of §555-3.04B.

Vibrating of concrete shall be in accordance with §555-3.04E except the number of vibrators required shall be one for every 40 cy of concrete placed per hour, with a minimum of two vibrators in use at all times, and equally spaced across the placement front. One additional vibrator shall be available for use as a backup.

**557-3.06 Cold Joints.** "Cold Jointing," the bonding of fresh concrete to set concrete, shall be done where indicated in the contract documents, or where approved by the DCES.



**A. Horizontal Joints.** Within 24 hours of the start of the placement, the hardened concrete shall have laitance and dirt removed by a high-pressure water wash. The high-pressure water wash shall be sufficiently strong to remove any laitance and dirt, but not damage the reinforcement or reinforcement coating. The pressure wash equipment shall be capable of providing pressure of 3000 to 5000 psi.

After pressure washing, the concrete shall be continuously wetted for a minimum of 12 hours immediately prior to deck placement. Before placing fresh concrete, all standing water shall be removed with oil-free compressed air. The surface shall be protected from drying to maintain a clean, saturated surface dry condition when placing the new concrete.

If the tops of precast/prestressed elements have been sealed with a penetrating sealer, pressure wash the tops a maximum of 2 hours prior to concrete placement. The requirement for prewetting is waived.

**B. Construction Joints.** The requirements of § 555-3.06 A. shall apply. Construction joints shall be placed only where shown in the contract documents or where permitted by the DCES.

In the event an ongoing placement is delayed excessively, the establishment of a bulkhead shall be required.

**557-3.07 Finishing Integral Wearing Surfaces on Superstructure Slabs.** Machine finishing shall be used throughout all superstructure concrete placement operations with the exception of areas which are inaccessible to finishing machines.

Machine finishing shall be accomplished with an approved power-driven, one-operation (strike-off and finishing) machine. The finishing machine shall have a strike-off auger set 1/4 to 1/2 inch above the finished surface, a power-driven roller or oscillating type screed, and a pan float.

Finishing machines shall be equipped with adjustable strike-off and finishing screeds, the bottom surfaces of which shall be adjusted to produce the required contour of the finished surface. Machines shall be kept in true adjustment. Machines out of adjustment shall not be used until proper adjustments have been made and the adjustments have been approved by the Engineer.

The specific method and equipment that the Contractor proposes to use for finishing will be supplied during the Preplacement Meeting and will be subject to approval by the Engineer based on the above listed requirements.

Finishing machine rail supports shall be accurately set and of substantial construction so that the finished deck surface will conform to the profile and transverse sections shown in the contract documents. Finishing machine rail supports shall be placed and adjusted to properly provide for the deflection of forms, falsework, and structural supporting members which will occur during the placement of the concrete. Finishing machine rail supports shall not be attached by welding to portions of flanges subject to tensile stresses. The finishing machine rail supports shall be spaced at a maximum of 2 feet on center. During stage construction, the support system shall be on the stage being placed.

Where the deck surface falls outside the fascia stringer flange, the finishing machine rail supports shall be placed on the forms. The forms shall be designed to take these loads through the use of outriggers or some other approved means.

Prior to commencing concreting operations, the finishing machine shall be given a test run over the full length of the superstructure segment to be paved, with the finishing machine adjusted to its finishing position. While operating the finishing machine during this test, the finishing machine rails shall be checked for deflection and proper adjustment, the cover on slab reinforcement measured, and the controlling dimensions of slab reinforcement and forms checked. All necessary corrections shall be made and verified by the Engineer before concreting is begun.

A sufficient amount of concrete equal to the finishing machine capacity shall be supplied at all times.

After the concrete has been placed, spread, and consolidated to provide a uniformly dense structural slab, the surface shall be struck off immediately by a single passage of the transverse finishing machine. The finishing machine shall carry sufficient concrete in front of the screed to fill low and porous places.

This operation shall be done only once and shall produce a uniformly consolidated dense smooth surface of the required contour. The passage of the strike-off auger shall provide a concrete surface slightly above grade so that after settlement, if any, and the disappearance of excess water from the surface, the passage of the finishing screed will result in a uniform surface at the required grade and contour over its entire area, and provide the required cover over reinforcing.

In areas which are inaccessible to finishing machines, use of approved manual vibratory equipped power screeds may be used, with written approval of the DCES.

Hand finishing shall be allowed only in areas inaccessible to finishing machines or manually driven vibratory-equipped power screeds. Hand finishing shall be performed in the same sequence and manner as machine finishing, unless otherwise permitted by the Engineer. Hand finishing shall be performed in such a manner as to produce a concrete surface with quality and uniformity identical to that produced by the finishing machine. Hand screeds or bullfloats shall be magnesium and 10 inches, or more, in width. Care shall be taken not to overwork the concrete surface during any finishing operation.

In the event the placement is delayed as a result of equipment breakdowns or delivery problems, all concrete in place shall be protected from evaporation by covering the surface with wet burlap, curing blankets, or plastic sheets. Excessive delays shall require the establishment of a bulkhead and the ceasing of the placement.

Prior to texturing, the finished concrete surface shall be examined by the Contractor and the Engineer using a straightedge. The straight-edge shall not be less than 10 feet long. It shall be furnished by the Contractor and maintained in good, usable condition at the placement site at all times. While the concrete is still plastic, surface depressions shall be filled with concrete of the same class as the placement in progress. Surface irregularities greater than 1/4 inch in 10 feet in either the longitudinal or the transverse direction shall be corrected in a manner acceptable to the Engineer. Thin mortar or laitance, which may have accumulated ahead of the finishing machine screed, shall be removed from the work site. They shall not be used to fill depressions.

After finishing, the surface shall be given a suitable texture with an artificial turf drag made of molded polyethylene with approximately 53,500 synthetic turf blades per square yard, each approximately 1/2 inch long. The artificial turf drag shall be of a type and brand appearing on the Department's Approved List.

The Contractor may apply texture in a transverse direction, longitudinal direction, or parallel to the finishing machine. Once begun, the direction of texturing shall not change. All texturing shall be done from a work bridge immediately following the finishing operation. Texturing shall be done prior to the beginning of curing operations. Only one pass of the turf drag over the finished area will be permitted.

If texturing is done in a transverse or skewed direction, the Contractor shall texture by hand methods immediately after finishing machine passage.

If texturing is done in the longitudinal direction the turf drag shall be a seamless strip and shall be attached to the work bridge such that the surface of the concrete is textured immediately after finishing machine passage. Small areas, otherwise inaccessible to the attached drag, may be textured by hand methods. Texture resulting from the drag shall stop within 1 foot of curbs.

The finishing movement and resulting progress of the turf drag shall be done in a manner so as to prevent ridges or gouges forming in the concrete surface. The drag shall be weighted and the contact area changed as required to produce an acceptable texture. The drag shall be cleaned periodically to remove all hardened concrete particles.

**557-3.08 Finishing Integral Wearing Surfaces on Structural Approach Slabs.** The requirements of §557-3.07 shall apply together with the following:

The Contractor may use an approved, manually driven, vibrator-equipped power screed in lieu of a power-driven transverse finishing machine. Only screed model types appearing on the Department's Approved List shall be employed for this work. The Engineer may require the use of a power-driven finishing machine if satisfactory results are not being attained.

**557-3.09 Finishing Surfaces to be Overlaid with Portland Cement or Asphalt Concrete.**

Machine finishing shall be used throughout all superstructure concrete placement operations, with the exception of areas which are inaccessible to finishing machines. In areas which are inaccessible to finishing machines, use of approved manual vibratory equipped power screeds may be used, with written approval of the D.C. E. S.

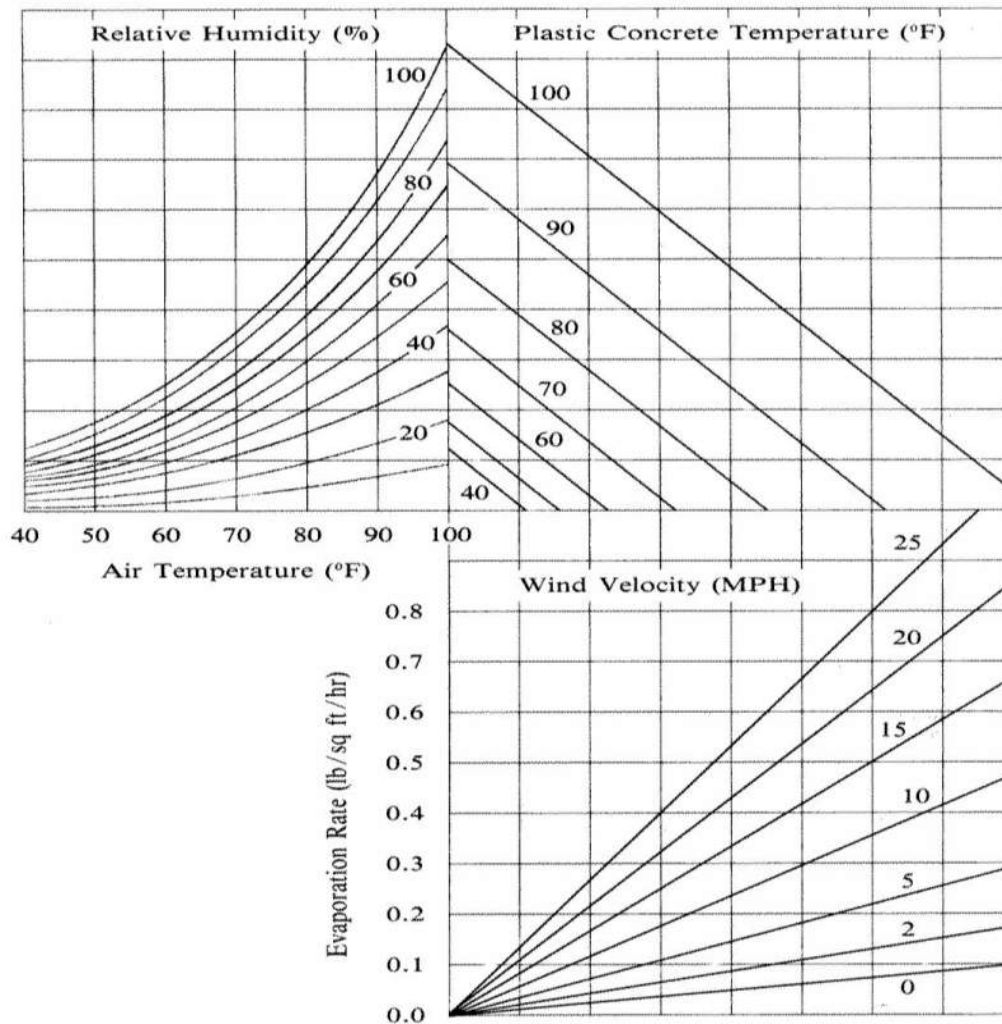
Surfaces shall be finished to a surface tolerance of 3/8 inch in 10 feet. The surface tolerance shall be verified by the Engineer with an approved straightedge not less than 10 feet long. The straightedge shall be furnished by the Contractor who shall maintain it in good condition at the paving site at all times.

Hand finishing shall be allowed only in areas inaccessible to finishing machines or manually driven vibratory-equipped power screeds. Hand finishing shall be performed in the same sequence and manner as machine finishing, unless otherwise permitted by the Engineer. Hand finishing shall be performed in such a manner as to produce a concrete surface with quality and uniformity identical to that produced by the finishing machine. Hand screeds or bullfloats shall be magnesium and 10 inches, or more, in width. Care shall be taken not to overwork the concrete surface during any finishing operation.

Upon completion of screeding, surfaces which will be overlaid with portland cement concrete shall be textured to conform to §557-3.07.

**557-3.10 Sidewalk and Safety Walk Finish on Bridges.** Sidewalks and safety walks shall be constructed by placing concrete continuously to an elevation slightly higher than shown in the contract documents. The concrete shall then be screeded to the correct elevations and worked with a magnesium float to give uniform surface. Floating shall be kept to a minimum, consistent with the desired finish, in order to avoid overworking the concrete. Follow floating with a broom finish. Surface scoring will not be permitted.

**FIGURE 557-1 STRUCTURAL CONCRETE EVAPORATION RATE**



To use this chart:

1. Enter with air temperature, move up to relative humidity.
2. Move right to plastic concrete temperature.
3. Move down to wind velocity.
4. Move left to read approximate rate of evaporation.

**557-3.11 Curing.** After finishing and plastic-concrete texturing operations are completed, the concrete surface shall be completely covered with clean, prewetted burlap. The allowable time period for wet burlap covering shall not exceed five minutes from the completion of texturing, and 30 minutes from the time of concrete placement. Care shall be taken so as not to damage the finished surface and texturing. The curing shall not be delayed beyond the specified period. Burlap shall be lapped a minimum of 1 foot. Lapped edges are not required to be sealed. Burlap shall be thoroughly saturated over its entire surface area and shall be drained of excess water prior to its application. Burlap shall be kept continuously wet, commencing 10 minutes from the time the wet burlap is placed, and protected from displacement. The Contractor may cover the wet burlap and soaker hoses only if it is necessary to maintain curing temperature.

The curing period shall begin only after all concrete for a given placement is complete. A curing day is defined as any day during which the ambient air temperature at the concrete surface is 45°F or higher for the entire day.

Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F.

An aggregation of 24 curing hours will be credited as one curing day. Aggregations of less than 24 curing hours will not be credited.

Curing hours will be determined with continuous recording thermometers. The number and placement of the thermometers will be determined by the Engineer. Thermometers used to monitor curing temperatures shall consist of the following types:

1. Continuously Recording Thermometer. The thermometer shall be capable of continuously recording temperatures within a range of 0°F to 120°F for a minimum of 24 hours.
2. Maximum - Minimum Recording Thermometer. For all placements the thermometer shall be capable of recording maximum and minimum temperatures in a range of 0°F to 120°F.

The curing temperature of concrete is the air temperature at the concrete surface, or the air temperature between the concrete surface and its protective covering. Temperatures at these locations are critical for proper concrete curing. For the purposes of this section the temperatures at the foregoing locations shall be maintained between 45°F and 85°F inclusive.

**A. Superstructure Slabs.** After the burlap placement has been fully completed, the concrete surface shall be cured for 14 curing days. The Contractor may use either option listed below. After seven curing days, the Contractor may be permitted to perform incidental work on the structure under the loading limitations of §557-3.14 Loading Limitations for Superstructure Slabs. The burlap may be displaced in limited areas, for short durations, to perform items such as sawcut grooving, placement of sidewalks, safety walks, curbing, bridge rail, and fencing. The amount of burlap displaced to perform these operations shall be limited to the immediate area affected by the Contractor's operations. All concrete surfaces exposed during these operations shall be kept in a saturated condition. Immediately after the work is completed in the affected area, all burlap shall be replaced for the duration of the curing period. Removable forms shall remain in place until the minimum curing period is complete. HPIC Concrete curing requirement is seven days.

**1. Fourteen-Day Continuous Wetting.** Leave all burlap in place for 14 curing days. Provide continuous, uniform wetting for the entire curing period.

**2. Wet Burlap and Curing Covers.** Provide continuous uniform wetting for seven curing days. After seven curing days, either of the following methods may be used:

- a. Remove all burlap after seven curing days. Apply curing covers immediately upon burlap removal. Plastic-coated fiber blankets are not required to be laid dry. Application and maintenance of covers shall be in accordance with §555-3.08A General. Concrete cured in this manner shall not be exposed to the atmosphere for more than 10 minutes between burlap removal and curing cover placement.
- b. Apply curing covers directly over the wet burlap. Plastic-coated fiber blankets are not required to be laid dry. Application and maintenance of covers shall be in accordance with §555-3.08A General. The concrete surface shall be inspected periodically to ensure that its condition remains saturated.

The Contractor shall inform the Engineer of the intended curing procedure at the Preplacement Meeting.

**B. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.** After the burlap placement has been fully completed, leave all burlap in place for 7 curing days. Provide continuous, uniform wetting for the entire curing period. Forms for curbs, sidewalks, and safety walks shall remain in place until the minimum curing period is complete. Forms for structural approach slabs shall remain in place until sufficient strength is achieved to avoid damage to the concrete. After removal of approach slab forms, the formed surfaces shall be cured as per the requirements of §555-3.08A.

**557-3.12 Provisions for Concreting in Cold Weather.** Cold-weather concreting provisions shall apply when the ambient air temperature below 45°F for 24 consecutive hours, or drops below 32°F at any time, during the curing or drying periods of the concrete.

When cold-weather concreting of superstructure slabs is progressed, curing shall be maintained in accordance with §555-3.08C *Provisions for Curing in Cold Weather*, except as modified here:

**A. Superstructure Slabs.**

The curing duration shall be 14 days (336 hours). Conditions may occur which prevent an entire 24 hour day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur the Contractor may aggregate curing hours. An aggregation of 24 curing hours will be credited as one curing day based on the Engineer's acceptance of monitored temperature data. Any aggregations of less than 24 curing hours will not be credited as a curing day. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F. Curing temperature is defined as the temperature of the air measured at the surface of the curing concrete.

Curing temperatures shall be maintained in accordance with the requirements of Table 555-2, *Cold Weather Curing Requirements*. If ambient air temperatures are expected to fall below 45°F, materials and equipment necessary to maintain required curing temperatures shall be present on the site or readily available. The contractor shall provide protection in a timely manner to maintain acceptable curing.

External heat and enclosures to maintain curing temperatures may be required, as determined by the contractors proposed curing methods documented at the Preplacement Meeting. Enclosures are defined as those materials, combinations of materials, or systems that provide for uniform temperature and curing management of the concrete. If enclosures are required, they shall be constructed in such a way that all surfaces of the fresh concrete shall be maintained between 45°F and 80°F for the curing period. On structures where bottom formwork is not required, the existing superstructure materials may be considered for their insulating values provided all curing temperature requirements are maintained. If the Contractor expects to, or will, perform work when ambient temperatures are below 45°F, the enclosure shall be constructed in such a manner that work can be performed inside the enclosure without exposing any concrete to a temperature below 45°F. All concrete surfaces within heated areas shall be protected from drying by the use of live steam or use of continuously wetted burlap. All concrete surfaces within heated areas shall be protected from surface disintegration of fresh concrete due to an accumulation of carbon dioxide gas by properly venting the enclosure or use of non-combustion type heating systems.

Continuously recording thermometers shall be placed on both the top and underside of the deck to monitor areas where extreme cold or heat can be expected. Multiple thermometers may be required as directed by the Engineer. On structures where bottom formwork is not required and the existing superstructure materials are considered for their insulating value, temperatures shall be monitored at

the interface between the existing superstructure materials and new concrete using continuously recording thermocouples and thermometers.

A maximum temperature differential of 30° F between any two locations within any form of enclosure, heated or otherwise, shall be maintained at all times.

When the ambient temperature is 45°F or greater, an enclosure may be removed for access to progress additional work providing there is a temperature difference of 30 Fahrenheit degrees or less between the air and the surface of the concrete. If the temperature difference between the air and the surface of the concrete is greater than 30 Fahrenheit degrees, temperatures shall be gradually reduced at a rate not to exceed 1°F /hr until the temperature difference is equal to or less than 30 Fahrenheit degrees. If an enclosure is removed, all heating in other areas shall cease until such time that the enclosure is replaced. Upon completion of the incidental work and replacement of the enclosure, the Contractor shall reestablish acceptable curing temperature differentials, with a maximum temperature differential not more than 30 Fahrenheit degrees between any two locations within the enclosure.

After seven (7) curing days, the Contractor may perform work on the structure to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For all incidental work, the requirements of §557-3.14, *Loading Limitations for Superstructure Slabs*, shall apply.

***B. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.***

The provisions of 557-3.12 A *Superstructure Slabs* shall apply except the curing duration shall be 7 days (168 hours). After three (3) curing days, the Contractor may perform work on approach slabs to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For structural approach slabs, the requirements of §557-3.15 *Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges*, shall apply.

***C. Saw Cut Grooving.***

When concrete is placed, cured, or dried under cold weather provisions, and a surface treatment option requiring saw cut grooving is used, saw cut grooving may be commenced after 7 curing days and shall be completed prior to commencing the drying period. Work shall progress only when ambient temperatures are 32°F or greater or within an enclosure as described in §557-3.12 A. Care shall be taken to prevent damage to the structure and no chipping or spalling of concrete shall occur at the sawcut edges.

***D. Winter Surface Treatment - Superstructure Slabs and Structural Approach Slabs.***

Upon completion of the curing period, the Contractor shall progress one of the following two options:

**1. Option 1.** The top surface and fascias of the superstructure slab shall be air dried for 10 days before being sealed with a penetrating sealer or exposed to freezing temperatures. Saw cut grooving shall be completed, as described above, prior to application of penetrating sealer. External heat and enclosures to maintain drying temperatures may be required. Drying shall be achieved by the following:

- a. Providing free air flow and maintaining temperatures between 45°F and 80°F to the top surface and fascias (vertical faces) of the superstructure slab. Fascia forms shall be removed to allow for free air flow.

b. Drying of the underside of the structure, and of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required. However, ambient temperatures shall be maintained between 45°F and 80°F in these areas for the duration of the drying period.

c. The drying period shall be continuous except that aggregate drying hours may be allowed when a contractor ceases free air flow for any reason but protects the drying concrete from exposure to any additional water. Exposure to any additional water, beyond minor leakage thru an enclosure in limited areas, will require the drying period to re-commence for 10 days. Any 3 hour period of time, or fraction thereof, when the concrete is exposed to minor leakage shall not be counted as part of the drying period. Minor leakage shall be defined as water that dries or evaporates in 3 hours or less. Limited areas are defined as areas less than 100 ft<sup>2</sup>. The total area of allowable minor leakage shall not exceed 5% of the concrete area under drying conditions. The same area of concrete shall not be exposed to minor leakage more than twice. Areas that exceed 100 ft<sup>2</sup> or are exposed to additional water that does not dry or evaporate in less than 3 hours, may be dried independently to accommodate removal of the original enclosure. Any independent enclosures shall be maintained under the same temperature and air flow requirements as the original enclosure for 10 days.

d. Means of accelerating the drying process will be considered by the Director, Materials Bureau, to achieve an internal moisture content of 85% relative humidity or less, measured at a depth of 1 inch from any concrete surface.

Once the drying period is complete, temperatures shall be gradually reduced at a rate not to exceed 1°F/hr until the temperature within the enclosure equals the temperature outside the enclosure. Application of a penetrating sealer, in accordance with other items shall be completed before opening the superstructure slab to traffic.

**2. Option 2.** The top surface and fascias of the superstructure slab shall be air dried for 24 hours before being sealed with an interim application of penetrating sealer or being exposed to freezing temperatures. No saw cut grooving will be performed. External heat and enclosures to maintain drying temperatures may be required. Work shall be progressed by doing the following:

a. Providing free air flow and maintaining temperatures between 45°F and 80°F to the top surface and fascias of the superstructure slab. Fascia forms shall be removed to allow for free air flow.

b. Drying of the underside of the structure, and of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required. However, ambient temperatures shall be maintained between 45°F and 80°F in these areas for the duration of the 24 hour drying period. Application of interim penetrating sealer shall be completed before opening the superstructure slab to traffic.

c. After April 1<sup>st</sup> the contractor shall clean the deck of debris and provide necessary site access. The Department will inspect the superstructure slab for freeze / thaw or scaling damage. Damage shall be defined as:

(1) Delaminations

(2) Surface defects as follows:

- Total combined area greater than 50 ft<sup>2</sup> with a scaling rating of 3 or greater as defined by ASTM C-672.
- Total combined area greater than 10 ft<sup>2</sup> where the surface distress is greater than 3/16 inch deep.



- (3) Pop-outs – surface imperfections greater than 3/4 inch in diameter
- d. If the above described damage exists, the Contractor shall repair any damaged or defective concrete greater than 3/16 inch deep by saw cutting the perimeter of the area to a depth of 3/4 inch, chipping any unsuitable material to 1-1/2 inch or sound concrete (whichever is deeper) with light, hand held, pneumatic tools, at a 45 degree angle into the repair area. Clean all repair area surfaces thoroughly by blast cleaning. Repair small areas 3 ft<sup>2</sup> or less using approved concrete repair material that provides a permeability less than 1200 coulombs, Item 701-04, preparing the surface according to the material manufacturer's recommendations. Repair larger areas using Class DP concrete, preparing the surface according to §584-3.02 and 584-3.03. Cure Class DP concrete for 7 days.
- e. After all necessary repairs are completed, the Contractor shall perform diamond grinding to the entire superstructure slab and approach slabs, to within 1 foot of any curb or barrier. Diamond grinding shall be performed as follows:
- (1) The depth of the grinding shall be approximately 3/16 inch to obtain a smooth texture.
  - (2) In all travel lanes, use equipment having gang-mounted diamond saw blades on a multi-blade arbor specifically designed for PCC pavement or superstructure production grinding. Using equipment capable of producing a 3 ft wide (minimum) grinding pass that is equipped with a vacuum system capable of removing slurry from the bridge deck surface, such as the Target 3800, Boart-Longyear (Kushion Kut) PC5000 or PC600, or equal as approved by the Director, Materials Bureau. Smaller diamond grinding equipment shall be used as necessary to complete grinding adjacent to curbs or barriers. The Contractor shall submit requests to use other equipment at least 7 days prior to the start of grinding operations.
  - (3) Begin and end diamond grinding lines normal to the bridge deck centerline. Grind the bridge deck longitudinally such that at least 95% of the bridge deck surface is ground and the bridge deck is in the same plane across a joint or crack when measured with a 3 ft (minimum) straightedge. When steel joints are specified, joints shall be placed to allow for the required grinding of 3/16 inch. Feathering of the grinding operation at steel joints shall be kept to a minimum. Provide surface drainage by maintaining the proper cross-slope on the finished surface and by blending adjacent passes. Regrind the bridge deck if an acceptable surface is not being obtained.
  - (4) Continuously remove slurry from the bridge deck using the vacuum system on the grinding equipment. If required, provide equipment capable of transporting the slurry from the job site to an acceptable waste area or facility, without spilling.
  - (5) Traffic may be allowed on ground areas after slurry removal is complete or on decks where only partial diamond grinding is complete.
  - (6) After diamond grinding is complete, concrete shall be saw cut grooved according to contract documents and specifications for saw cut grooving, followed by penetrating sealer application placed in accordance with contract documents and specifications for penetrating sealers.

***E. Winter Surface Treatment –Curbs, Sidewalks and Safety Walks on Bridges.***

Upon completion of the curing period, concrete shall be air dried for 24 hours by providing free air flow and maintaining temperatures between 45°F and 80°F to all concrete surfaces. The drying period shall be continuous. Upon completion of drying, curbs, sidewalks and safety walks shall be sealed with a penetrating sealer in accordance with contract documents.

**557-3.13 Removal of Forms.** Removal of forms for superstructure slabs shall meet the requirements of §555-3.09 Form Removal and as modified herein. The minimum curing period prior to form removal is 10 curing days, except that for cold weather concreting a minimum of 14 curing days is required unless

minimum compressive strengths are achieved as determined by the D.C. E. S. A curing day is defined in §555-3.08A. Permanent field connections, if required, shall be made on the same day prior to removal of forms and falsework.

The following inspection procedures will be used as a check to insure the soundness of the concrete structural slab adjacent to the steel forms. Not less than two days after completion of a concrete structural slab pour, but prior to the next slab pour, the Contractor shall remove a section of the steel form from the most recently completed pour of each span, at a location selected by the Engineer, in order to provide visual evidence that the concrete mix or the construction procedures are obtaining the desired results. If either the concrete mix or the construction procedures are varied significantly within a pour, such as a change in the extent of vibration or change in the workability of the mix, the Contractor shall remove another section of form to verify that the new procedures yielded desirable results.

After the concrete has been placed in a span for a minimum of ten days but prior to any further work performed on the superstructure in that span, the Engineer will spot-check the underside areas of the steel forms by sounding with a suitable-weight hammer at least 50% of the area of at least 25% of the individual form panels on a random basis to determine whether any honeycomb or void areas exist. If such areas are detected, the Contractor shall remove the forms from these areas for a visual inspection of the slab.

The amount of sounding and form removal may be reduced after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the results of the inspections as outlined above indicate that sound concrete is present throughout the slabs.

If, after removing a section of form, the concrete is found to be defective, additional panels shall be removed. All defective concrete shall be repaired to match the adjacent concrete in section and color.

The form sections shall be removed by a metal saw or air-carbon-arc gouging with minimum damage to the concrete. Cuts shall only be sufficiently deep to sever the form. Any other method of removal shall be submitted to the Deputy Chief Engineer (Structures) for approval. Cuts that are parallel to the corrugations in the forms shall be located on the sloping surface midway between a crest and a valley. Cuts parallel to the supporting beams shall be made through the supporting angles taking care not to damage the structural steel beams. The Contractor will not be required to replace the removed forms.

The Contractor shall provide all the facilities required for safe, suitable and convenient means of access to the forms for the Engineer's inspection.

**557-3.14 Loading Limitations for Superstructure Slabs.** Superstructure slabs, during the curing period, may be subjected to a vehicle load not to exceed 10 tons, or a wheel load not to exceed 3 tons no sooner than seven curing days after placement. Full legal loading may commence using either of the following options:

- A. Superstructure slabs may be subjected to full legal loads no sooner than 14 calendar days after completion of the curing period.
- B. The Contractor may subject a superstructure slab to its full legal load upon completion of the curing period, or any day thereafter provided that the procedure below is followed:
  - 1. The Contractor shall notify the Engineer at the Preplacement Meeting of the intention to subject the slab to full legal load prior to the 14th day after completion of curing.
  - 2. During the slab concrete placement, the Engineer will cast two sets (pairs) of test cylinders in addition to each set cast for record and cure the cylinders on site in the same manner as the superstructure slab.
  - 3. The Engineer will forward cylinders to the Materials Bureau or Regional Testing Facility. One set will be tested fourteen calendar days after placement and, if necessary, the second set will be tested twenty-one calendar days after concrete placement. Under no circumstances will cylinders be tested sooner than fourteen calendar days after the concrete placement they represent.

4. Concrete cylinder sets (pairs) designated for advance testing shall achieve an average compressive strength of 3000 psi, or greater, with individual cylinders having a compressive strength of 2800 psi, or greater.
5. Results of compression tests will be transmitted to the Engineer as soon as possible. The Engineer will inform the Contractor of the cylinder testing results and allow early loading if appropriate. If the required compressive strengths are not achieved, the requirements of §557-3.14A shall apply.

**557-3.15 Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges.** During the curing period, approach slabs may be subjected to a vehicle load not to exceed 10 tons, or a wheel load not to exceed 3 tons. The Contractor may subject structural approach slabs, sidewalks, and safety walks to their full legal load upon completion of the 7-day curing period.

**557-3.16 Damaged or Defective Concrete.** Damaged or defective concrete shall be defined by, and repaired in accordance with, the requirements of §555-3.13, Defective or Damaged Concrete.

Subsequent to placement of concrete, either before or after setting, the Engineer will verify at random that the vertical clear distance from the top of the structural slab to the top mat of main reinforcing, as shown on the contract plans, is correct within a tolerance of plus or minus 1/2 inch. If the allowable tolerance is exceeded, the Engineer shall reject the work so advise the Contractor and the Deputy Chief Engineer (Structures), in writing, stating the deficiencies upon which the rejection is based.

The Deputy Chief Engineer (Structures) shall review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:

- The affected placement shall be removed and replaced in whole or in part.
- The Contractor shall provide special corrective measures as directed by the Deputy Chief Engineer (Structures).
- The concrete placement shall be accepted without corrective action.

After the concrete has hardened, the Engineer will examine it using the Contractor's straightedge. Surface irregularities greater than 1/4 inch in 10 feet shall be corrected. Unless otherwise directed by the Regional Materials Engineer, the concrete used for repairs shall be of the same materials as that used for the original placement.

**557-3.17 No Bar list provided.** When no bar lists are provided in the contract documents the following shall apply:

1. At least thirty (30) days prior to fabrication of the reinforcement the Contractor shall submit a minimum of two copies of the bar lists and placement drawings showing the bar locations to the Engineer. The details of the bar list and placement drawings shall meet the requirements of the current edition of the Concrete Reinforcing Steel Institute's publication Reinforcing Bar Detailing. Placement drawings shall be size "B". Drawings and bar lists shall be clear and legible.
2. Requests for information or changes along with reasons shall be documented in a separate list.
3. The Engineer will transmit the documents to the designer for review for conformance with the design requirements in accordance with the Shop Drawing Approval process. The designer will not be checking lengths, number of bars, weights or bar marks. Corrections will be returned to the Contractor. When the documents are satisfactory they will be returned to the Contractor stamped "Approved In Conformance With Design Requirements".
4. Partial submissions that require coordination with other drawings will not be accepted.

**557-4 METHOD OF MEASUREMENT.** The work will be measured for payment in square yards of superstructure slab, approach slab, or sidewalk and safety walks installed, measured to the nearest 0.1 square yards.

Winter surface treatment of superstructure and approach slabs will be measured for payment in square yards of superstructure and approach slab, measured to the nearest 0.1 square yard.

**557-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing bar reinforcement, wire fabric for concrete reinforcement, copper flashing, flexible water stops, mechanical connectors where specified, sheet packing, water for wetting, joint sealing compounds, joint fillers, concrete curing materials, including any materials for temperature management during the curing period and the cost of screed rail supports and other brackets or braces necessary to support finishing machines.

If permanent metal forms are used, the cost of furnishing all facilities required for access, removing the permanent forms for inspection or repair purposes, painting the cut edges of the forms and repairing the concrete as required herein shall be included in the price bid for this work.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Progress payments will be made on a per-span basis as follows:

Forty (40) percent of the area will be paid for after all reinforcing is properly placed. Forty (40) percent of the area will be paid for after the concrete has been properly placed and proper curing applications have been instituted. The remainder will be paid for after completion of all curing, and necessary corrective work.

The unit price bid for Surface Treatment of Superstructure and Approach Slabs shall include all labor, materials and equipment necessary to satisfactorily complete the work including work zone traffic control for work associated with deck cleaning, evaluation, and diamond grinding. The cost for interim penetrating sealer applied under §557-3.12C.2., prior to the concrete being exposed to freezing conditions, shall be included in this item. The cost for saw cut grooving and final application of penetrating sealer will be paid for under separate items and paid for only once.

Winter Surface treatment – Superstructure Slabs and Structural Approach Slabs shall only be paid when environmental conditions related to temperature and moisture protection during the drying period require use of enclosures.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
557.0101	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 1 Friction	Square Yard
557.0102	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 2 Friction	Square Yard
557.0103	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 3 Friction	Square Yard
557.0109	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 9 Friction	Square Yard
557.0501	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Not Required – Type 1 Friction	Square Yard
557.0502	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Not Required – Type 2 Friction	Square Yard
557.0503	Superstructure Slab with Integral Wearing Surface – Bottom Formwork Not Required – Type 3 Friction	Square Yard
557.0509	Superstructure Slab with Integral Wearing Surface - Bottom Formwork Not Required – Type 9 Friction	Square Yard
557.07	Superstructure Slab with Separate Wearing Surface – Bottom Formwork Required	Square Yard
557.09	Superstructure Slab with Separate Wearing Surface – Bottom Formwork Not Required	Square Yard

557.13	Class D Concrete	Square Yard
557.2001	Structural Approach Slab with Integral Wearing Surface – Type 1 Friction	Square Yard
557.2002	Structural Approach Slab with Integral Wearing Surface – Type 2 Friction	Square Yard
557.2003	Structural Approach Slab with Integral Wearing Surface – Type 3 Friction	Square Yard
557.2009	Structural Approach Slab with Integral Wearing Surface – Type 9 Friction	Square Yard
557.22	Structural Approach Slab with Separate Wearing Surface	Square Yard
557.29	Winter Surface Treatment – Superstructure Slabs and Structural Approach Slabs	Square Yard
557.30	Sidewalks and Safety Walks	Square Yard
557.4101	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Required, Type 1 Friction	Square Yard
557.4102	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Required, Type 2 Friction	Square Yard
557.4103	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Required, Type 3 Friction	Square Yard
557.4109	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Required, Type 9 Friction	Square Yard
557.4301	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Not Required, Type 1 Friction	Square Yard
557.4302	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Not Required, Type 2 Friction	Square Yard
557.4303	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Not Required, Type 3 Friction	Square Yard
557.4309	Superstructure Slab with Integral Wearing Surface – HPIC Bottom Formwork Not Required, Type 9 Friction	Square Yard

## **SECTION 558 - LONGITUDINAL SAWCUT GROOVING OF STRUCTURAL SLAB SURFACE**

(Last Revised September, 2019)

**558-1 DESCRIPTION.** Sawcut grooves into the surface of a portland cement concrete structural slab at the locations indicated in the contract documents.

The Contractor is hereby notified that concrete curing requirements, combined with structural slab loading restrictions, may have a significant effect upon the specific time, relative to concrete placement, at which sawcut grooving may be performed. The Contractor shall be familiar with the limits imposed by these factors and conduct operations accordingly.

**558-2 MATERIALS.** Use multibladed wet saw cutting equipment using circular saw blades. The Engineer may allow the use of single blade, circular saw equipment, where it is determined such equipment is necessary to complete the work as required. The equipment the Contractor proposes to use will be subject to the approval of the Engineer, prior to use.

Use water which meets the requirements of §712-01.

**558-3 CONSTRUCTION DETAILS.** Sawcutting concrete produces silica dust. Include sawcutting of concrete in the Health and Safety Plan in accordance with the silica safety requirements of §107-05 L.4.

Start sawcutting only after the specified curing period has elapsed, unless otherwise allowed by the applicable specification.

Cut longitudinal grooves parallel to the centerline of roadway using a single pass. Space the center-to-center of grooves at 0.75 inch +/- 10%. Cut all grooves rectangular in shape conforming to the following dimensions:

Width 0.1 inch (+ 20%, - 0)                      Depth 0.15 inch +/- 50%

During the grooving operations, the Engineer will verify, at random, that the minimum groove depth is being achieved. Should the Engineer determine that minimum groove depth is not being achieved, the Contractor shall stop grooving operations and make all adjustments necessary to achieve the minimum depth.

Supply the Engineer with two (2) accurate, easily readable gauges with which to verify groove depth. Deliver the gauges and applicable manufacturer's instructions for use, if necessary, no later than one week prior to the anticipated beginning of grooving operations.

Terminate grooves within the following limits unless otherwise indicated on the contract documents:

Location	Closest Allowable Distance	Farthest Allowable Distance
Drainage structure	4 inches	15 inches
Vertical face (curb or parapet), or face of railing (no curb)	4 inches	15 inches
Joint System (Dimension measured perpendicular from the edge of the joint system)	4 inches	15 inches

Using a self-contained system, continuously collect any slurry or debris created by the grooving operation such that it does not accumulate on the surface.

**558-4 METHOD OF MEASUREMENT.** The quantity will be measured as the number of square yards of structural slab satisfactorily grooved, measured between the faces of barrier, curb, or rail, and between the ends of the slabs, computed to the nearest whole square yard. No deduction will be made for areas left ungrooved near curbs, barriers, rails, joints, drainage structures, or other objects embedded in the slab.

**558-5 BASIS OF PAYMENT.** The unit price bid per square yard shall include the cost of all labor, materials, and equipment necessary to complete the work.

*Payment will be made under:*

Item No.	Item	Pay Unit
558.02	Longitudinal Sawcut Grooving of Structural Slab Surface	Square Yard

## **SECTION 559 - PROTECTIVE COATINGS FOR STRUCTURAL CONCRETE**

(Last Revised January, 2022)

**559-1 DESCRIPTION.** The work in this section shall include work required for protective coatings of concrete.

**559-1.01 Scope.** Apply a protective sealer to concrete surfaces to slow down/reduce the ingress of water and chlorides into the concrete at locations indicated on the plans or as directed by the Engineer.

### **559-1.02 Definitions**

- A. Penetrating Type Protective Sealers** – A Penetrating Sealer is a type of sealer that is applied to a concrete surface and has the ability to penetrate the surface and chemically bond to the concrete.

These are used on both new and existing concrete bridge decks and traffic bearing surfaces to include, but not limited to: approach slabs, bridge deck overlays, and sidewalks. Penetrating Sealers are also used on new structural concrete and precast concrete elements that are subject to water and/or chloride exposure and require long term protection.

- B. *Coating Type Protective Sealers*** – A Coating Sealer is a type of sealer that is applied to the surface of existing concrete when a uniform appearance is required. These are two part systems which consist of a primer coat followed by a top coat. Coating Sealers are used on new and existing concrete surfaces when an aesthetic appearance is desired, as they can hide stained or underlying repair areas while providing protection to the concrete.

## **559-2 MATERIALS**

### **559-2.01 Protective Sealing of Structural Concrete**

The protective sealers to be used on concrete surfaces shall be on the Approved List and meet the requirements of one of the following subsections:

- §717-03 Penetrating Type Protective Sealers
- §717-04 Coating Type Protective Sealers

The protective sealer required for use on all traffic and/or pedestrian bearing surfaces shall be a Penetrating Type Protective Sealer which has a 100% solids content as noted on the Approved List.

Penetrating Type Protective Sealer manufactured after April 1, 2022 shall be tinted with a fugitive dye such that the sealer is readily distinguishable upon the concrete surface for at least 4 hours after application but shall become inconspicuous within 7 days after application.

## **559-3 CONSTRUCTION DETAILS**

### **559-3.01 Protective Sealing of Structural Concrete**

**A. *General.*** Provide the Engineer with the Sealer Manufacturer's written instructions for application and the proposed method of surface preparation and sealer application at least 7 days prior to the start of work. Only one brand and specific type of sealer off the Approved List will be allowed for use on each individual element of a project (i.e., each pier, bridge deck, abutment, etc.). Follow all sealer manufacturer's written instructions except as modified herein.

**B. *Surface Preparation.*** For both new and existing concrete applications, care shall be taken while preparing and cleaning the surfaces to be sealed to ensure that all contaminants are satisfactorily removed without undue damage to the concrete surface or exposure of coarse aggregate. Contaminants may include but not be limited to grime, dirt, laitance, efflorescence, curing compounds, standing water, oil, paint, or other foreign particles which may prevent penetration or adhesion of the sealer. Prepare the surface for sealing by utilizing a procedure with appropriate equipment that will satisfactorily complete this work, in accordance with the sealer manufacturer's written instructions and subject to the approval of the Engineer. Surface preparation methods usually consist of either: sand, shot, or water blasting with a minimum water blast pressure of 7,000 psi. Upon completion of the cleaning process, the concrete surface shall be free of any remaining residue. All surface preparation work shall be completed and approved by the Engineer, prior to sealer application.

**1. New Bridge Decks and Bridge Deck Overlays.** All required surface texturing, saw cut grooving, diamond grinding, and construction of barriers, parapets, and walks shall be completed prior to the surface being prepared for sealing. All new concrete bridge decks and bridge deck overlays to be sealed shall air dry for a minimum of 72 hours after completion of the required curing period. If the concrete is subjected to rain or moisture from other operations, the drying period shall be extended 24 hours from the time that the concrete has stopped being wetted. After the drying period has ended, the concrete surface shall be lightly cleaned in accordance with the sealer manufacturer's written instructions followed by vacuum cleaning to prepare the surface and remove any contaminants or loose particles. If water blasting is utilized, the surface shall be air dried upon completion for a minimum of 24 hours or as specified in the sealer manufacturer's written instructions, whichever is longer, before the sealer can be applied. The deck shall be clean and free of all debris prior to sealer application. If a new bridge deck or bridge deck overlay is subjected to traffic for 21 days or more prior to sealing, the concrete surface shall be thoroughly cleaned in accordance with the sealer manufacturer's written instructions before sealer can be applied.

**2. New Structural Concrete.** All new structural concrete that is to be sealed shall air dry for 14 days after completion of the required curing period or for the length of time specified in the sealer manufacturer's written instructions, whichever is longer. If the concrete is subjected to rain or moisture from other project operations, the drying period shall be extended 24 hours for every day the concrete is subjected to water. After the drying period has ended, the concrete surface shall be lightly cleaned in accordance with the sealer manufacturer's written instructions followed by vacuum cleaning, to prepare the surface and remove any contaminants or loose particles. If water blasting is utilized, the surface shall be air dried upon completion for a minimum of 24 hours or as specified in the sealer manufacturer's written instructions, whichever is longer, before the sealer can be applied. The concrete surface shall be clean and free of all debris prior to sealer application.

**3. Existing Structural Concrete and Existing Bridge Decks.** Existing concrete surfaces to be sealed shall be thoroughly cleaned with light sand or shot blasting, in accordance with the sealer manufacturer's written instructions followed by vacuum cleaning, to prepare the surface and remove any contaminants or loose particles. Where the use of sand or shot blasting is prohibitive, water blasting may be allowed, provided the Contractor can demonstrate the ability to provide a clean, porous surface in accordance with the requirements of the sealer manufacturer's written instructions. If the concrete is subjected to rain or moisture from other operations such as water blasting, upon completion the surface shall be air dried for a minimum of 24 hours or as specified in the sealer manufacturer's written instructions, whichever is longer, before the sealer can be applied. Surface preparation of any concrete or bridge deck surfaces with existing coatings known to be asbestos containing shall be performed subsequent to coating removal and completed in accordance with Section 210 of the Standard Specifications.

### **C. Sealer Application**

**1. Weather Limitations.** Sealer materials shall not be applied during wet weather conditions or when adverse weather conditions are anticipated within 12 hours of the completion of sealer application or as specified in the sealer manufacturer's written instructions, whichever is longer. Ambient and surface temperatures shall be a minimum of 40°F and rising during application until the sealed concrete is dry to the touch. Application by spray methods will not be permitted during windy conditions if unsatisfactory coverage will result.



**2. Yield Check.** If penetrating sealer is to be applied in a single coat to a traffic bearing surface, the Contractor shall demonstrate to the satisfaction of the Engineer that the proposed equipment and procedure will result in uniform coverage at the application rate specified on the Approved List before sealer can be applied.

**3. Application.** The protective sealer shall be used as supplied by the manufacturer without thinning or alteration with exception of the fugitive dye. Equipment for sealer application shall be compatible with sealer manufacturer requirements, in good working order, clean of foreign materials and approved for use by the Engineer. The quantity of sealer material delivered to the project shall be demonstrated by direct measurement in the presence of the Engineer prior to commencement of sealing application. Assumptions of volumes of unopened containers will not be permitted. The sealer shall be applied by brushing, spraying, or rolling, as recommended by the sealer manufacturer. The direct measurement shall be repeated in the presence of the Engineer when sealer application work is complete to verify the quantity of sealer applied.

- a. **For Penetrating Type Protective Sealers** – Apply sealer in one or more coats in accordance with the sealer manufacturer’s written instructions. The total quantity of sealer applied by all coats shall be equal to the quantity required at the application rate specified on the Approved List. The application rate for all traffic and pedestrian bearing surfaces shall be 200 ft<sup>2</sup>/gal. Additional coats shall be applied perpendicular to the previous coat. Care shall be taken when applying each coat, such that running or pooling does not occur. The final coat shall be allowed to dry according to the sealer manufacturer's written instructions before opening to traffic. On sloping and vertical concrete surfaces, sealer application shall progress from bottom to top. Care shall be taken to ensure that the entire surface of the concrete is covered, and all pores filled.

A 1-pint sample of sealer is required to be taken at a random time during sealer application from the point of application (i.e., from the nozzle of sprayer or spray bar or from the sealer container where sprayers, brushes or rollers are loaded) for quality assurance purposes. This sample shall be submitted to the Department’s Central Testing Laboratory (CTL), to the attention of the Chemistry Lab for evaluation. Additional samples may be requested by the Department at any time.

- b. **For Coating Type Protective Sealers** – Apply in accordance with the Contract Plans and the sealer manufacturer's written instructions.

**559-4 METHOD OF MEASUREMENT**

The quantity to be measured for payment will be in the number of square feet of concrete sealed measured to the nearest whole square foot.

**559-5 BASIS OF PAYMENT**

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
559.01	Protective Sealing of Structural Concrete on New Bridge Decks and Bridge Deck Overlays	Square Foot

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559.02	Protective Sealing of New Structural Concrete	Square Foot
559.03	Protective Sealing of Existing Structural Concrete and Existing Bridge Decks	Square Foot
559.04	Protective Sealing of Concrete with Coating Type Protective Sealer	SquareFoot

## SECTION 560 - MASONRY

**560-1 DESCRIPTION.** Under this work the Contractor shall furnish and place masonry, with or without coping, of the type, shape, size, color and location indicated in the plans, proposal or as directed by the Engineer.

**560-2 MATERIALS.** Materials shall meet the requirements specified in the following subsections of 700 - Materials:

Split Faced Concrete Brick	704-10
Precast Concrete Coping	704-11
Caulking Compound for Structures	705-06
Premolded Resilient Joint Filler	705-07
Masonry Mortar	705-21
Bar Reinforcement - Grade 60	709-01
Wire Fabric for Concrete Reinforcement	709-02
Admixtures	711-08

**560-2.01 Dimension Stone Masonry.** All stone shall be sound, durable, free from reeds, rifts, seams, laminations and minerals which would cause discoloration or deterioration from weathering. The stone shall be of size, quality and color acceptable to the Regional Director. Duplicate samples of stone showing the complete color range shall be submitted to the Regional Director for approval. Stone shall be quarried so the stratification will be radial or parallel to the bed when set in place except where split face or seam face finish is called for on the plans. All beds and joints shall have a "Fine Point or Sawn Finish" for at least 2 inches from the arris lines. The balance shall not fall off from a straight line for more than 1/6 of the stone's minimum dimension. When stones project beyond adjoining faces, the fine pointing shall be carried at least 2 inches in from the adjoining surfaces (arris lines of stone or face of concrete).

Soffits of ring stones shall be cut to the curve of the arch and shall have a "Fine Point or Sawn Finish" unless otherwise shown on the plans. All other showing surfaces shall be finished as indicated on the plans.

On square bridges and on bridges where the skew is 30 degrees or less, the ring stones shall be cut so the joint sides are parallel to the faces of the abutments. On bridges with a skew greater than 30 degrees the ring stones shall be cut so the joint sides of each stone will be at right angles with the face. Soffit joints shall lie in a horizontal plane.

"Fine Point or Sawn Finish" shall be as described in §560-2.07, Definition of Finishes.

**560-2.02 Split Faced Concrete Masonry.** Split faced concrete masonry units shall be new, sound, durable, true to size, free from laminations and cracks, and uniform quality which complies with the requirements of §704-10. All split face concrete masonry units delivered to the site shall be of the sizes necessary to produce the wall pattern as indicated on the plans.

An approved mechanical self-leveling splitting machine with two steel knives, one directly above the other will be used for all field splitting. Four samples of each thickness of each split faced concrete masonry unit shall be submitted to the Engineer for tentative approval. They shall be labeled with the contract title and number, the Contractor's name, and manufacturer's name. The split faced concrete

masonry units used in the work shall be equal in all respects, color, quality, texture and surface to the approved samples.

Anchors shall be a metal slot formed from sheet zinc not less than 0.025 inches in thickness, bent to form a dovetail channel 5/8 inch wide at the front, 1 inch wide at the rear, 1 inch deep and with wings 1/8 to 1/4 inch wide. The slots shall be provided with a felt insert to prevent the entrance of fresh concrete. These inserts shall be removed just prior to the insertion of the ties. Ties shall be formed of zinc not less than 0.078 inches thick, 1 inch wide with one end designed to fit snugly into the anchor slots and shall be crimped with corrugations 1/8 inch deep, but no less than 1/16 inch deep.

The ties shall be at least 4 inches long. The Contractor shall submit to the Engineer for tentative approval four samples of the material used to fabricate the ties, i.e. anchors, felt and ties.

**560-2.03 Stone Masonry.** All stone shall be sound, durable, properly quarried, free from reeds, rifts, seams, laminations and minerals which would cause discoloration from weathering. Samples of stone shall be submitted to and be approved by the Regional Director prior to the beginning of any work on this masonry. The size, color and quality of the stone delivered to the site shall be substantially in accordance with the approved samples.

The stones may have an average variation of 1/6 of the thickness shown on the plans, however, they shall have a minimum thickness of at least 2/3 that shown on the plans and a maximum thickness of 1/6 over the maximum thickness shown on the plans.

**560-2.04 Rubble Stone Masonry.** All stones shall be clean, free from structural defects and acceptable to the Engineer. Selected stones, roughly squared and pitched to line, shall be used at all angles and ends of walls.

**560-2.05 Precast Concrete Coping.** Precast concrete coping units shall be new, sound, durable, true to size, free from laminations and cracks and of uniform quality which complies with the requirements of §704-11.

**560-2.06 Mortar.** Use 705-21 Masonry Mortar.

**560-2.07 Definition of Finishes.** Finishes of stone or manufactured masonry units shall be defined as shown in Table 560-1.

### 560-3 CONSTRUCTION DETAILS

**560-3.01 General.** Masonry or precast concrete coping shall not be constructed when the ambient temperature is 40°F or below, or when the stone or masonry units contain frost, except by written permission of the Engineer and subject to any conditions the Engineer may require.

Stone, masonry units or coping units shall not be dropped upon or slid over existing masonry, nor shall hammering or turning of stones, masonry units or coping on the masonry be allowed. Stones, masonry unit or coping units shall be carefully set without jarring masonry already laid, and they shall be handled in a manner so as not to cause disfigurement.

<b>TABLE 560-1 MASONRY UNITS, SURFACE FINISH</b>	
<b>Finish Name</b>	<b>Maximum Surface Projection Beyond Pitch Lines</b>
Smooth Finish	1/16 inch
Fine Point or Sawn Finish	1/4 inch
Rough Finish	1/2 inch
Scabbed Finish	3/4 inch
Seam and Split Face	1 inch

Rock Face	1/10 the vertical height of the individual stone
Thermal Finish	1/4 inch

**NOTE:** All faces of Dimension Masonry shall extend to the pitch lines shown on the plans.

**560-3.02 Dimension Stone Masonry.** The provisions of §560-3.01 shall apply with the following additional requirements:

**A. Preparation of Stone and Bed.** Each stone shall be cleaned and thoroughly saturated with water before being set. The bed which is to receive the masonry shall also be cleaned and moistened.

**B. Bedding of Stone.** All stone shall be well bedded in mortar and settled in place with a suitable wooden maul before the setting of the mortar.

**C. Spalls not Permitted in Mortar Beds.** No pinning up of stones with spalls will be permitted, and no spalls will be permitted in beds.

**D. Expansion Joints.** All surfaces of stone in contact with expansion joint material shall be made smooth, unless otherwise shown on the plans. The joints shall be filled with premolded resilient joint filler and sealed with an approved joint sealer as shown on the plans, or as ordered by the Engineer.

All joints in concrete backing shall be protected against intrusion of water into or through the joint by the installation of an approved water stop. The water stop shall be embedded into the concrete at least 3 inches on each side of the joint and shall be installed as near to the inside face of the concrete backing as practicable. The water stop may be of ASTM B370, 20 ounce preformed copper strip, 0.025 inch minimum thickness, soldered to be water tight and continuous, or may be approved flexible water stop as shown on the plans. Water stops shall be manufactured and installed so as to provide for the expansion and contraction movements present at the joint.

In case any stone is moved or the joint broken, the stone shall be taken up, the mortar thoroughly cleaned from beds and joints, and the stone reset in fresh mortar.

Joints shall not be filled by pouring in a thin or liquid mortar.

**E. Pointing (new construction) and Tuck Pointing (raking out and repointing).**

**1. Pointing.** Tool the face joints with a pointing tool before the mortar sets, as approved by the Engineer. Avoid smearing the masonry surfaces with excess mortar forced out of the joints. For joints not pointed when the masonry is laid, prepare the joints for pointing by following the tuck pointing procedures. There will be no separate payment for this work.

**2. Tuck Pointing (Repointing).** Repoint the joints in masonry where indicated on the Contract plans or directed by the Engineer. Use an Item 705-21 Type M, S or N masonry or mortar cement, tuck pointing mortar (or a specially designed one) with the same or weaker strength than the original mortar, as approved by the Engineer.

Remove soft, loose, cracked and deteriorated mortar to a minimum depth (measured from the wall face) of twice the average joint width, and remove all deteriorated mortar beyond the minimum depth, as ordered by the Engineer. Do not damage the masonry during the removal process. Clean all contamination from the prepared joints.

Prior to repointing, flush with water and leave all surfaces to be re-mortared in a dampened, surface dry state. Pack the prepared joints in layers with mortar that closely matches the original color and texture, allowing each layer to become thumb-print hard before the next. Use at least two layers when the joint depth is twice the joint width. Apply a final layer thickness that does

not exceed the joint width. When the final layer is thumb-print hard, finish with a pointing tool that recreates the original joint shape, or as approved by the Engineer.

Perform pointing when the ambient temperature is 40°F or above, and the masonry is frost free. Avoid recessed joints that hold water.

After the mortar sets, clean all mortar and cement stains from other surfaces. In direct sunlight, keep the newly pointed masonry moist for at least 3 days. In shade, moisten 2 to 3 times a day for at least 3 days.

**F. Drawings.** The contract plans show the general character of the masonry. Prior to the beginning of any work, the Contractor shall prepare and submit for the approval of the Regional Director, three sets of detail plans for all dimension masonry shown on the plans. The Contractor shall carefully check and assume full responsibility for the accuracy of this work. These detail plans will be examined and either approved or returned without approval to the Contractor, who shall check the indicated corrections and resubmit two sets of prints of revised details. When the detail plans have been approved, the Contractor shall furnish the Regional Director with three sets, one of which shall be reproducible. The drawings shall conform to the size and type of requirements for Shop Drawings set forth in the New York State Steel Construction Manual.

**560-3.03 Split Faced Concrete Masonry.** The provisions of §560-3.01 shall apply with the following additional requirements:

**A. Sample Wall.** The Contractor shall construct a split faced concrete masonry wall 6 feet long and 4 feet high of approved units and matching mortar at a location designated. This procedure shall be repeated until a sample wall is approved by the Engineer. The approved sample wall shall be maintained intact until the Engineer directs its removal.

In lieu of the field sample wall, the Contractor may show, for approval, a building constructed with units of the same type, color, texture and surface finish required. The field sample wall shall be required if the building masonry is not approved.

Upon approval of the sample wall or building, the Contractor shall furnish and lay split masonry to conform with the approved sample wall.

**B. Protection and Handling.** Split faced concrete masonry units shall be protected by a wrapping of 4 mil polyethylene, and shall be handled on pallets by mechanical means, or by hand or tongs. Dumping of the masonry units from trucks, wheel barrows or other conveyances is prohibited. Particular care shall be taken to protect all edges and the face of the masonry units. Distorted, laminated, checked or cracked masonry units will be rejected and removed from the site of construction.

On delivery to the site, the masonry units shall be neatly piled off the ground, on pallets or other approved implements, and protected from moisture by wrapping them with 4 mil polyethylene.

Masonry units which become wet, shall not be laid in the wall until their conformance with the specifications for §704-10 is shown by tests. The cost of these tests shall be borne by the Contractor.

**C. Laying.** The split faced concrete masonry shall be laid up, in the pattern shown on the plans, by skilled masons and in a first-class manner. The masonry shall be laid true to line and grade in level horizontal beds and be properly anchored. Each masonry unit shall be laid in a full mortar bed and in a manner to form a full end joint in one operation. The space between the split face masonry and the supporting concrete shall be filled with mortar and rodded until the mortar rises to the top of the masonry unit as each unit is placed.

**D. Bonding.** The split faced concrete masonry shall be bonded to the supporting concrete. Dovetail anchors shall be continuous, set vertically and spaced on centers not exceeding 1 foot on the concrete walls. Ties shall be installed in the anchor slots at a maximum vertical height of 1 foot on centers.

**E. Joints.** Joints in the exposed face shall be struck with a concave jointing unless otherwise specified. The joints shall be 3/8 inch wide and the concave jointing shall be 1/8 inch deep at the center.

**F. Protection Against Weather.** The split faced concrete masonry shall be protected against the action of the weather. The tops and at least 2 feet down the sides of all walls not completed shall be constantly protected with suitable waterproof covering properly secured in place during periods of suspended work. The facing shall be so protected until it has been bonded to the concrete wall and completely sealed against moisture. During hot dry weather, the masonry shall be protected from the sun and kept moist for at least three days after completion.

**G. Protection Against Damage.** Projections and angles exposed to damage shall be boxed or otherwise protected to prevent damage. Any units damaged during the progress of the work shall be replaced with new units at the Contractor's expense.

**H. Cleaning of Exposed Faces of Mortar and Drippings.** Exposed faces of split faced concrete masonry units shall be cleaned free of excess mortar and mortar drippings, as the work progresses, to prevent excessive rubbing during final cleaning operations.

**I. Expansion and Contraction Joints.** Expansion and contraction joints shall be constructed as shown on the plans. The surfaces of the joints shall be plumb, true to line and smooth to the caulking compound.

**J. Final Cleaning.** After the completion of adjacent work likely to soil the masonry, the split faced concrete masonry shall be thoroughly cleaned, removing all dirt, dust, mortar, stains, etc. The concrete masonry shall be brushed, while dry, with stiff fiber brushes. If this brushing does not clean the masonry to the satisfaction of the Engineer, then the Contractor shall clean the facing with soap powder in clean water applied with stiff fiber scrub brushes. After scrubbing with soap and water the Contractor shall rinse the masonry with clean water. The Contractor may, with the Engineer's approval, substitute a cleaning solution that will not harm the concrete or mortar joints. The cleaning operation shall in all cases start at the top and proceed downward.

**K. Caulking.** When the split faced concrete masonry has received the final cleaning, all expansion and contraction joints shall be filled at least 1 inch deep with caulking compound.

All surfaces to receive the caulking compound shall be clean, free of loose materials, dirt, dust, frost, moisture, oils, laitance or curing compounds and shall be primed with clear lacquer, shellac or the manufacturer's recommended primer after the surfaces have been cleaned. A bond breaker shall be used as a release material back of the caulking compound. The bond breaker may be polyethylene, specially treated bond inhibiting pressure sensitive tape or any approved equal. The caulking compound shall be tooled with a concave joint finishing tool to provide a neat smoothly finished joint of uniform width. Where solvents are required on the jointing tool, they shall be as recommended by the manufacturer of the caulking compound.

**560-3.04 Stone Masonry.** The construction provisions of §560-3.02 shall apply. The individual stones shall be trimmed, recut and dressed, as may be necessary at the site, to obtain a pattern in the finished wall which will be in character with the requirements of drawings, specifications and the approved sample wall.

The following general requirements will apply to the placing of stone masonry:

**A. Cross-Joints, Steps or Ladders.** There shall be no cross-joints, steps or ladders.

**B. Subdivision of Rectangles.** There shall be no subdivision of rectangles.

**C. Stone Shapes.** There shall be no unusually shaped stone.

**D. Clusters.** There shall be no clusters of stone of the same length and height.

**E. Horizontal Joint Length.** There shall be no continuous horizontal joint greater in length than 10 feet.

**F. Vertical Joints.** There shall be no more than five stones abutting any one vertical joint.

**G. Stone Proportions.** There shall be no stone longer than six times its height nor shorter than one and one half times its height. The length of the average stone shall be three to five times its height.

**H. Horizontal Joints.** Horizontal joints shall not have a slope varying from the horizontal by more than one percent.

**I. Color.** Where stone masonry and dimension masonry are specified, for the same structure or in close proximity to each other, there shall be no great contrast in size or color between the Stone Masonry and the Dimension Masonry.

Prior to beginning the work the Contractor shall lay up a sample wall conforming to the requirements of §560-3.03A except that the material details for the work shall conform to those for Stone Masonry.

**560-3.05 Rubble Stone Masonry.** The provision of §560-3.01 shall apply with the following additional requirements:

The stone shall be laid to form substantial masonry presenting a neat, finished appearance. The minimum size of stone to be used shall be 4 inches in depth or rise, 9 inches in width, and 12 inches long. Spalls and pinnars will not be allowed to show on the face of the work and shall be used otherwise only where necessary. All stones shall be soundly and completely bedded in the mortar. The length of stretchers shall not exceed three times their rise, and the width of stretchers shall in no case be less than one and one-half times their rise. At least one-fourth of the stones in the face shall be headers and shall be evenly distributed. The length of headers shall be not less than 32 inches nor more than the thickness of the wall, where the work is 4 feet or less in thickness. Where the work is more than 4 feet thick, the length of headers shall be not less than 32 inches. The width of headers shall be not less than their rise. All stones shall be laid to break joints 6 inches or more and to thoroughly bond the work. No joint in the face shall be over 1 inch in width. Backing shall be good-sized, well-shaped stones so laid as to break joints. Spaces between stones shall be filled with spalls set in mortar. The degree of roughness of exposed faces shall be measured with a 6 foot straight edge supported between adjacent projections on the stone face. Variations in the stone face, in excess of 4 inches, measured from the straight edge to the extreme depression in stone or mortar will not be permitted. Rear faces shall present approximately plane surfaces.

Pointing shall conform to the requirements of §560-3.02E.

**560-3.06 Rubble Stone Masonry Laid Dry.** The specifications of §560-3.05, Rubble Stone Masonry, shall apply except that no mortar shall be used and the requirements of §560-3.01 Construction Details (General), pertaining to frost shall not apply unless otherwise directed by the Engineer.

**560-3.07 Precast Concrete Coping.** The provisions of §560-3.02, Dimension Stone Masonry and §560-3.03, Split Faced Concrete Masonry, shall apply with exception of §560-3.02D, §560-3.03A, and §560-3.03D.

**560-3.08 Tuck Pointing.** Apply the provisions of §560-3.02E2 Tuck Pointing. For re-caulking work, rake out any old caulking to a minimum 1 inch depth and follow the provisions of §560-3.03K. Caulking. Do not damage masonry during the removal and cleaning process.

#### **560-4 METHOD OF MEASUREMENT**

**560-4.01 Dimension Masonry.** Dimension masonry will be measured as the number of square feet (including joints within the dimension masonry) measured on the plane of all the exposed surfaces of the dimension masonry incorporated in the work.

**560-4.02 Split Faced Concrete Masonry.** Split faced concrete masonry will be measured as the number of square feet (including joints within the masonry and between the split faced concrete masonry and the concrete wall, and the mortar bed for precast concrete coping), on the plane of all exposed surfaces of the masonry incorporated in the work. Split faced masonry below the finished surface of the ground or paving shall be considered as exposed in computing the area for payment. The approved, constructed, split faced concrete masonry sample wall will be paid for as split face concrete masonry.

**560-4.03 Rubble Stone Masonry.** Payment for rubble stone masonry will be made for the number of cubic feet within the payment lines shown on the plans and placed in accordance with the specifications. Concrete, mortar or any joint material within these payment lines will, for the purpose of payment, be classified as stone masonry and will not be paid for under any other item.

**560-4.04 Stone Masonry.** Payment for stone masonry will be made for the number of square feet (including joints within the stone masonry) measured on the plane of all the exposed surfaces of the stone masonry incorporated in the work. Mortar joints between concrete and stone masonry will be paid for as stone masonry.

Stone masonry shown on the plans below the finished grade or sidewalk (to prevent the possible exposure of unfaced concrete) shall be considered as exposed in computing the payment area for this item.

Thirty square feet will be used in payment for the complete accepted sample wall required in this specification.

#### **560-4.05 (Vacant)**

**560-4.06 Precast Concrete Coping.** The quantity to be paid for will be the number of feet of precast concrete coping (including the joints between the coping units) placed in accordance with the plans, specification and orders of the Engineer.

**560-4.07 Tuck Pointing.** The Engineer will measure this work in the field as the number of square or linear feet of masonry pointed and cleaned, as bid. Linear measurements will be made along the joint centerline.

#### **560-5 BASIS OF PAYMENT**

**560-5.01 Dimension Stone Masonry.** The unit price bid per square feet shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Concrete, dimension masonry, mortar or any joint material within the nominal thickness of the dimension masonry will, for the purpose of payment, be classified as dimension masonry and will not be



paid for under any other item. Projections, if any, into the concrete beyond the nominal thickness of dimension masonry will be paid for as the class of concrete displaced by the stone. No deduction will be made for railing post holes.

Mortar Joints between Dimension Masonry and Concrete will be paid for as Dimension Masonry.

Mortar Joints between Dimension Masonry and Stone Masonry will be paid for as Stone Masonry.

**560-5.02 Split Faced Concrete Masonry.** The unit price bid per square feet shall include the cost of furnishing all labor, materials (including anchors, ties, premolded bituminous joint material, and caulking compound) and equipment necessary to complete the work. The payment shall also include the labor, materials and equipment necessary to remove and dispose of all constructed sample masonry panels when directed by the Engineer.

No payment shall be made to the Contractor for the submitted alternate sample walls or for any unapproved sample walls.

The cost of furnishing and placing anchoring devices shall be included in the unit price bid for this work.

The cost of erecting and disposing the sample wall shall be included in the unit price bid for this item.

**560-5.03 Stone Masonry.** The unit price bid per square feet shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Concrete, stone masonry, mortar or any joint material within the nominal thickness of the stone masonry will, for the purpose of payment, be classified as stone masonry and will not be paid for under any other item. Projections, if any, into the concrete beyond the nominal thickness of stone masonry will be paid for as the class of concrete displaced by the stone. No deduction will be made for railing post holes.

The cost of furnishing and placing anchoring devices shall be included in the unit price for this item.

**560-5.05 Rubble Stone Masonry.** The unit price bid per cubic feet for Rubble Stone Masonry with joints or laid dry, shall include the cost of furnishing all labor, materials and equipment necessary to complete the work except excavation will be paid for under the appropriate excavation item.

**560-5.06 Precast Concrete Coping.** The unit price bid per feet shall include the cost of furnishing all labor, materials (including anchors, reinforcement, premolded resilient joint materials, and caulking compound) and equipment necessary to complete the work.

**560-5.07 Tuck Pointing.** Include all labor, material (including any re-caulking material), and equipment to complete the work in the unit bid price.

**560-5.08 Progress Payments.** Progress payments will be made, at the unit price bid, for 75% of the quantity properly placed. The balance of the quantity will be paid for upon proper cleaning and caulking of the joints.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
560.01	Dimension Stone Masonry	Square Foot
560.02	Split Faced Concrete Masonry	Square Foot
560.0401	Stone Masonry	Square Foot
560.05	Rubble Stone Masonry	Cubic Foot
560.06	Rubble Stone Masonry Laid Dry	Cubic Foot
560.07	Precast Concrete Coping	Foot
560.08	Tuck Pointing	Foot
560.09	Tuck Pointing	Square Foot

## SECTION 561 (VACANT)

## SECTION 562 - REINFORCED CONCRETE THREE-SIDED STRUCTURES

**562-1 DESCRIPTION.** The work consists of designing and constructing reinforced concrete three-sided structure(s) at the location(s) indicated on the Plans.

A reinforced concrete three-sided structure is composed of some of the following discrete elements:

1. Span Unit
2. Span Unit Footing
3. Wing Wall with Footing
4. Headwall
5. Invert Slab with Cut-off Wall
6. Apron with Cut-off Wall

**NOTE:** Any of the above elements may be cast in place at no additional cost to the State.

**562-2 MATERIALS.** Materials for all precast concrete components shall meet the requirements of the PCCM. Materials for cast-in-place concrete shall be Class HP concrete meeting the requirements of Section 555 and modified to include corrosion inhibitor meeting the requirements of 711-13. The penetrating type protective sealer shall meet the requirements of 717-03. Reinforcement shall meet the requirements of Section 556.

### 562-3 CONSTRUCTION

**562-3.01 Design.** An appropriate structure design and all details necessary for construction meeting the Design parameters given in these specifications shall be developed and submitted to the DCES for approval. All design work, detail development, and proposed handling and installation procedure development, shall be done by a Professional Engineer. The design submittal shall conform to the requirements stated in the PCCM. The DCES reserves the right to reject a proposed design(s) if the structure type is determined to be unsuitable for the proposed application based on safety, durability, serviceability, or maintainability.

The Load Rating shall be determined in accordance with the current AASHTO *"Manual for Bridge Evaluation"* with all interim provisions in effect. The contractor shall show which method (allowable stress or load factor) was used in load rating computations. Load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. The load ratings shall be shown on the Production Note Sheet of the shop drawings. The contractor shall include all load rating computations in the design calculation submittal.

**562-3.02 Design Parameters.** The design of the structure(s) described above shall meet the following:

1. Design Specification : NYSDOT LRFD Bridge Design Specifications.
2. Live Load : HL-93 and the NYSDOT Design Permit Vehicle.
3. Highway Profile Section : As shown in the contract documents.
4. Soil Parameters : As shown in the contract documents.
5. Layout, Span, Rise, and Length of the Bridge Structure : As shown in the contract documents.
6. Staged Construction : Construction staging shall be as shown in the contract documents.
7. Wing Walls : As shown in the contract documents.

8. Railing or Barrier : The railing anchorages or barrier anchorages on the structure shall be designed to develop adequate global and local capacities required to resist the loads in Section 13 of the NYSDOT LRFD Bridge Design Specifications.
9. Hydraulics : The proposed structure shall provide hydraulic area (effective flow area) below the design high water elevation shown in the contract documents.
10. Allowable Concrete Stress : As per the provisions of the NYSDOT LRFD Bridge Design Specifications, except that maximum tensile stress in concrete for handling and erection loads when analyzed according to the proposed handling and installation procedures, shall not exceed  $0.15 \sqrt{f'_{ci}}$ , where  $f'_{ci}$  is the concrete compressive strength at the time being considered.
11. Joints : All joints between Span Units shall be designed to be leak proof. The determination of the acceptability of the proposed joint system by the DCES shall be final.
12. Cover to Reinforcing : NYSDOT Bridge Manual, Chapter 15

**NOTE:** The shape(s) of the Span Unit shown in the contract documents is for illustration purposes only. Other shapes meeting the design parameters are acceptable, unless otherwise noted in the contract documents.

**562-3.03 Changes to Design Parameters.** If the Contractor wants to propose a structure not in full compliance with the design parameters in the contract, a preliminary proposal, fully explaining the changed design parameters shall be submitted to the DCES for review and approval. The Contractor is not expected to develop a detailed design until the proposed design parameters have been approved by the DCES.

**562-3.04 Design Computations, Shop Drawings/Detail Drawings.** The preparation and submission for review and approval shall be according to the PCCM. Shop drawings shall show detailed handling procedure to be used during fabrication, storage, and transportation of the precast elements. All necessary supporting calculations shall be included in the design computation package.

Fabrication of all steel components shall meet the requirements of the SCM.

Shop drawings shall show the required tolerances for the geometry of all precast components, placement of reinforcement, location of all inserts, etc. Design shall consider the effects of these tolerances.

**562-3.05 Fabrication.** Fabrication of all precast elements shall be according to the PCCM.

**562-3.06 Installation Drawings.** Installation drawings shall meet the requirements of the PCCM and the following:

- A. Details of all joints including all materials and a step-by-step procedure for installing them shall be shown on the installation drawings.
- B. All welding operations during installation shall be shown on the installation drawings and shall meet the requirements of the SCM.
- C. Details for all cast-in-place concrete not detailed in the contract documents.

**562-3.07 Installation.** Installation of all precast elements shall be according to the approved installation drawings. All elements after installation and prior to backfilling will be inspected for cracks or other visible defects. All defective elements shall either be replaced or be repaired using procedures approved by the DCES and at no additional cost to the state.

Cast-in-place elements shall have laitance removed by blasting and shall be coated with penetrating type protective sealer.

**562-3.08 Erection Drawings.** A separate set of erection drawings shall be prepared and submitted for review and approval of the Department as per the provisions of Section 2.6 ERECTION DRAWINGS of the PCCM.

**562-3.09 Tolerances (After Erection)**

- A. Joint Width:  $\pm 3/8$  inch
- B. Vertical Difference Between Top of Adjacent Units:  $\pm 1/2$  inch
- C. Span - Variation From Post-Pour Measurement Recorded on the Shipping Paperwork:  $\pm 3/8$  inch

**562-3.10 Backfilling**

A. Backfilling operations shall not begin until:

1. Span units to span unit footing key joints are grouted as shown on the approved installation drawings and have cured a minimum of 24 hours.
2. Transverse connections between unit segments are placed and secured (if required).
3. Joint seals are properly placed and approved by the Engineer.

B. Backfilling operations shall be conducted in accordance with Section 203 - Excavating and Embankment, with the following modifications:

1. Fills shall be placed and compacted in layers not exceeding 12 inches in depth.
2. Dumping for filling operations shall not be nearer than 3 feet to a plane passing vertically through the back face of any footing.
3. Backfill shall be placed as symmetrically as possible around the structure with differential depths of backfill on opposite sides of the structure span units not exceeding 18 inches.
4. Fill within 1 foot of any surface of the structure shall be compacted with hand compaction equipment.
5. Vibratory rollers shall not be used within 10 feet of any surface of the structure.
6. Construction equipment shall not travel or rest on an uncompleted structure unless the designer of the structure span unit has evaluated the loading conditions, submitted calculations to the DCES, and has received written approval of the proposed loading. Actual conditions at the time of loading, including both the weight of the fill and the equipment, shall be part of the analysis. The Contractor shall repair any damage resulting from equipment passage at no additional cost to the State.

**562-4 METHOD OF MEASUREMENT.** Measurement for payment for the Reinforced Concrete Span Units, Wing Walls, Apron, and Invert Slabs will be computed from the payment lines shown on the plans. No field measurements will be made. The quantity to be paid under this work for the Reinforced Concrete Span Units, Invert Slab with Cut-Off Wall and Concrete Apron with Cut-Off Wall shall be the number of square yards of plan area. The quantity to be paid under this work for the Wing Wall with Footing shall be the number of square yards of face area.

**562-5 BASIS OF PAYMENT.** The Contractor shall include the cost of all engineering, labor, materials, and equipment necessary to complete the work in the unit price bid. The Contractor shall include the costs of the footings, headwalls, and cut-off walls in the unit price bid of the element to which it is attached.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
562.01nn	Reinforced Concrete Span Units	Square Yard
562.02	Invert Slab With Cut-Off Wall	Square Yard
562.03	Wing Wall with Footing	Square Yard
562.04	Concrete Apron With Cut-off Wall	Square Yard

**NOTE:** Serialization for the Span Units: nn represents the specific structure identifier.

## **SECTION 563 - PRESTRESSED CONCRETE UNITS (STRUCTURAL)**

**563-1 DESCRIPTION.** This work shall consist of furnishing and placing prestressed concrete units for structures, as specified in the contract documents.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all prestressed concrete units (structural) and the fabricator of any steel diaphragms for the prestressed concrete units in accordance with §106-01 Sources of Supply.

### **563-2 MATERIALS**

**563-2.01 Prestressed Units.** Prestressed concrete units shall meet the requirements of the P.C.C.M.

**563-2.02 Transverse Tie Rods or Strands.** Refer to P.C.C.M., Section 4.

**563-2.03 Shear Key Material.** Refer to P.C.C.M., Section 4.

**563-2.04 Anchorage Block-Out Grout.** Refer to P.C.C.M., Section 4.

**563-2.05 Concrete.** The concrete shall meet the requirements of §718-06, High Performance Concrete For Precast and Prestressed Bridge Beams.

**563-2.06 Diaphragms.** The requirements of §718-07 shall apply.

**563-2.07 Grouted Reinforcing Bar Splice Sleeves** shall meet the requirements of §709-15 Grouted Reinforcing Bar Splice Sleeves.

**563-3 CONSTRUCTION DETAILS.** The requirements of the P.C.C.M. shall apply.

### **563-4 METHOD OF MEASUREMENT**

**563-4.01 Prestressed Concrete I-Beam Units.** The quantity to be paid for under this work shall be the number of feet (horizontal length center-to-center of bearings or anchor dowels, as shown on the plans) of each unit furnished and placed in accordance with the plans and specifications.

**563-4.02 Prestressed Concrete Box-Beam Units and Hollow and Solid Slab Units.** The quantity to be paid for under this work shall be the number of square feet of plan area of each prestressed unit installed. Plan area is defined as the area bounded by the centerline of bearings and the outer edges of each prestressed unit. No deductions will be made for chamfers, shear keys, or notch cuts. Space between the units shall not be included in any measurement.

**563-5 BASIS OF PAYMENT.** The unit price bid for these units shall include all labor, materials, diaphragms, and equipment necessary to complete the work except that bearings shall be paid for under their respective items.

Damaged units which cannot be satisfactorily repaired or which do not meet dimensional and camber tolerances shall be replaced by the Contractor at no cost to the State.

Progress payments will be made when each unit is furnished and placed in accordance with the plans and specifications exclusive of preparing and filling joints. Payment will be made at the unit price bid for 90% of the quantity properly placed. The balance of the quantity will be paid for upon completion of the work. The completion of work will include the correct preparation and filling of the joints as well as the tightening of transverse ties.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
563.010X	Prestressed Concrete I-Beam Units (Types 1-6)	Foot
563.02	Prestressed Concrete Box Beam Units	Square Foot
563.03	Prestressed Concrete Hollow Slab Units	Square Foot
563.04	Prestressed Concrete Solid Slab Units	Square Foot
563.05	Prestressed Concrete New England Bulb Tee Units	Foot

*X = Type Designation (1 through 6)*

**SECTION 564 - STRUCTURAL STEEL**

(Last Revised May, 2019)

**564-1 DESCRIPTION.** This work shall consist of fabricating, furnishing and erecting structural steel and other metal parts in accordance with the contract documents and as directed by the Engineer.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all structural steel in accordance with §106-01 *Sources of Supply*.

**564-2 MATERIALS.** Materials for this work shall meet the requirements of the New York State Steel Construction Manual (SCM) and the following subsections of Section 700 *Materials and Manufacturing*:

Structural Steel	715-01
High Strength Bolts, Nuts and Washers	715-14
Pins and Rollers	715-15

Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of §715-01 *Structural Steel*.

**564-2.01 Structural Steel Replacement - Stock Steel Option.** Stock steel may be furnished for components that are not fracture-critical members (FCMs). For FCMs, stock material shall be supplied only with the approval of the DCES. If furnished, the stock steel shall comply with the provisions of §715-01 *Structural Steel*. Positive heat identification will be required for all stock steel. Certified copies of the results of chemical analysis and physical tests shall be furnished to the Department.

**564-3 CONSTRUCTION DETAILS.** All structural steel work, including, but not limited to fabrication inspection, transportation, and erection shall be performed in accordance with the provisions of the SCM. Shop inspection will be provided unless otherwise noted on the contract plans, or waived by the DCES.

Shop drawings prepared for Structural Steel Replacement shall be prepared, approved and distributed in accordance with the provisions of the SCM, except that the term DCES shall be interpreted as the Engineer.

**A. Shop Drawings.** The Contractor shall provide all shop drawings and/or prints required by the contract documents or the Steel Construction Manual. Any prints required beyond the number specified shall be furnished by the Contractor at cost.

**B. Laminar Defects at the Boundary of Tension Groove Welds.** The Contractor shall provide all work and materials required for the correction or elimination of laminar defects at the boundary of tension groove welds.

The cost of all ultrasonic testing and repairs and the cost of replacement of defective portions of plates where partial replacement is approved shall be borne by the Contractor and included in the price bid for structural steel.

**C. Inspection of Bolted Connections.** The Contractor shall provide all labor and equipment necessary for the performance of inspection of bolt tightness during structural steel fabrication and erection. The State will witness the bolt testing, but will not provide equipment or labor.

**D. Qualification Test for Welders, Welding Procedures and Electrode and Flux Combinations.** The Contractor shall provide tests required to qualify welders, welding procedures and electrode and flux combinations. All tests shall be witnessed by the Department.

**E. Radiographic Inspection.** The Contractor shall provide radiographic inspection and of preparation for radiography, together with the cost of providing access and of furnishing adequate facilities for the review of radiographs in the shop or field.

**F. Ultrasonic Inspection.** Ultrasonic inspection (UT) that is to be performed in the shop as per the requirements of the SCM shall be performed by a NYSDOT certified UT technician employed by or under contract to the fabricator. Any UT inspection work to be done on the job site will be performed by the State or its designated representative. The Contractor shall perform any required preparation and furnish access to the weld joints to be inspected.

**G. Magnetic Particle Inspection.** The Contractor shall provide magnetic particle inspection when specified or required by the inspector to verify limits of defects discovered during visual inspection.

**H. Repair of Defects in Welds and Base Metal.** The Contractor shall repair defects found by visual inspection or nondestructive tests at no additional cost to the State.

**I. Field Inspection of Rejected Material or Material Not Offered for Shop Inspection even though Required to be Shop Inspected by the Contract Documents.** When the Department, at its discretion, permits inspection of the materials to be performed at the contract site, all costs of this inspection shall be borne by the Contractor as a condition of the Department's approval of inspection of this material, at no additional cost to the State.

**J. Straightening Bent Material and Correcting Camber Deficiencies.** The Contractor shall perform all corrective work required to straighten bent material and correct camber deficiencies, when permitted, at no additional cost to the State.

**K. Field Repair, Reaming and Drifting of Holes.** The Contractor shall provide all work permitted for the correction of unacceptable holes at no additional cost to the State.

**L. Metal Scuppers.** The Contractor shall provide Metal scuppers as structural steel unless otherwise noted in the contract documents.

**M. Adjustment and Alignment of Bearings.** The Contractor shall provide all labor, materials and equipment required for adjustment and alignment of bearings.

**N. Field Splices.** Field splice locations and details are shown in the contract documents. If the Contractor wishes to change the location of the splice(s), the Contractor shall submit a request to the Engineer for approval by the DCES in accordance with Section 203.5 of the SCM.

**O. Photographs.** The Contractor shall provide photographs requested by the DCES in accordance with the provisions of the SCM.

**P. Testing of Stock Steel.** The Contractor shall provide all labor, materials and equipment necessary to perform chemical and physical tests on stock steel when such tests are required.

**Q. Heat-Curving and Cambering.** The Contractor shall provide nondestructive testing, repairs or replacement of material damaged due to over stressing or destructive heating during heat-curving or cambering.

**564-4 METHOD OF MEASUREMENT.** Castings, forgings, fasteners, anchor bolts for other than bridge bearing installation, cables and other metal parts used in the permanent construction, will be measured as structural steel, even if made of other materials.

**564-4.01 Pound.** The quantity to be measured for payment will be in pounds to the nearest whole pound. The weight of each shipping unit shall be clearly shown on the approved shop drawings.

**A. Payment Weight.** The weight of metal as shown on the approved shop drawings, shall include permanent bolts and welds in the structure as erected. The weight of all required bolts, nuts, washers, and all required welds will be estimated by adding 3% to the steel weight estimate, making no allowance for waste, and included in the weight for which payment will be made.

The weight of all erection materials including but not limited to bolts, pilot and driving nuts, temporary protective coatings, and all boxes, crates or other containers used for packing, together with sills, struts, and rods used for supporting members during transportation, will be excluded from the measurement for payment.

**B. Computed Weight.** The density of steel used in computing weights for payment will be assumed to be 490 pcf. The density of cast iron will be assumed to be 450 pcf.

The weights of rolled shapes and of plates of all dimensions will be computed based on their nominal weights as required by the dimensions shown on the approved shop drawings. If the Contractor elects to use steel members with weights that are greater than the nominal weights specified on the approved drawings for its convenience, the computations will be based on the nominal weight values shown on the approved shop drawings. Deductions will be made for copes, cuts and all holes except those holes required for high-strength bolts.

The weights of castings will be computed from the dimensions shown on the approved shop drawings, with an addition of 10% for fillets and overrun.

**564-4.02 Each.** The quantity to be measured for payment will be made on an 'Each' basis.

**564.4.03 Lump Sum.** The work will be measured for payment on a lump sum basis.

## 564-5 BASIS OF PAYMENT

The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, not including bridge bearings and associated anchor bolts.

**Payment will be made under:**

Item No.	Item	Pay Unit
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564.05XX	Structural Steel (Type 01-22)	Lump Sum
564.10nnnn	Structural Steel Replacement	Pound
564.51nnnn	Structural Steel	Pound
564.70nnnn	Structural Steel Replacement	Each

NOTE: nnnn denotes a serialized pay item.

## SECTION 565 - BRIDGE BEARINGS

**565-1 DESCRIPTION.** The work shall consist of furnishing, placing and setting bridge bearings at the locations indicated on the plans.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all bridge bearings in accordance with §106-01 Sources of Supply.

**565-1.01 Bearing Types.** There are various types of bearings. The specific type required will be indicated on the plans. Bearing types are:

**A. Type S.R. - Steel Rocker Bearings.** These accommodate rotation by pivoting around a pinned joint. They are fabricated in fixed and expansion versions. The expansion version accommodates longitudinal movement by means of a curved rocker rotating on the bearing surface. Steel rocker bearings do not allow for transverse movement. This type of bearing shall only be used in rehabilitation situations where only one or two bearings are to be replaced on a bridge.

**B. Type S.S. - Steel Sliding Bearings.** These accommodate rotation by means of a rocker. They are fabricated in fixed and expansion versions. The expansion version accommodates movement with a sliding element. Steel sliding bearings do not allow for transverse movement. This type of bearing shall only be used in rehabilitation situations where only one or two bearings are to be replaced on a bridge.

**C. Type M.R. - Multi-Rotational Bearings.** These accommodate rotation by the deformation of a confined elastomeric element, or an unconfined urethane disc. Multi-rotational bearings are fabricated in fixed and expansion versions. The expansion version accommodates movement by means of sliding elements. Expansion versions may be guided, allowing movement in only one direction, or non-guided, allowing multi-directional movement.

**D. Type E.P. - Plain Elastomeric Bearings.** These accommodate rotation by the deformation of a plain elastomeric pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

**E. Type E.L. - Steel Laminated Elastomeric Bearings.** These accommodate rotation by the deformation of a laminated elastomeric and steel pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

**F. Type E.B. - Elastomeric Bearings with External Load Plates.** These accommodate rotation by the deformation of a plain or steel laminated elastomeric pad. Elastomeric bearings with external load plates are fabricated in fixed and expansion versions. The fixed version will accommodate rotational movements. The expansion bearings will accommodate longitudinal, transverse, and rotational movements.

## 565-2 MATERIALS

**565-2.01 General.** Materials shall meet the following requirements:

Concrete Grouting Material	701-05
Steel Anchor Dowel	709-01 <sup>a</sup>
Disc-Design Structural Bridge Bearings	716-06
Pot-Design Structural Bridge Bearings	716-07
Plain Elastomeric Bridge Bearings	716-10
Steel-Laminated Elastomeric Bridge Bearings	716-11
Elastomeric Bridge Bearings with External Load Plates	716-12
Rubber-Impregnated Woven Cotton Fabric	728-01
Rubber-Impregnated Random Fiber Pad	728-02
Plain Rubber Pad	728-03
Nuts	ASTM A563
Washers	ASTM F436
Anchor Studs	ASTM F3125 GRADE A325 or A449 Type 1
Cap Screws	ASTM F835M or A574M
Structural Steel Paint Class 1	708-01

**NOTE a.** Steel anchor dowels shall meet the requirements of §709-01 - Bar Reinforcement.

**565-2.02 Fabrication.** Steel components of bridge bearings shall be fabricated in accordance with the applicable requirements of the NYS Steel Construction Manual (SCM). In addition, component parts of individual bearings shall meet fabrication details as shown in the contract documents.

**A. Type S.R. Bearings.** These shall conform to the plans and other contract documents.

**B. Type S.S. Bearings.** These shall conform to the plans and other contract documents.

**C. Type M.R. Bearings.** These shall conform to the requirements of either §716-06.01 or §716-07.01 as applicable, and other contract documents. When type M.R. bearings are specified, the Contractor may supply either disc design or pot design bearings. Only one bearing design, disc or pot, shall be supplied for any one bridge.

**D. Type E.P. Bearings.** These shall conform to the requirements of §716-10 and other contract documents.

**E. Type E.L. Bearings.** These shall conform to the requirements of §716-11 and other contract documents.

**F. Type E.B. Bearings.** These shall conform to the requirements of §716-12 and other contract documents.

**565-2.03 Drawings.** Shop drawings shall meet the requirements specified in the following:

Type S.R. and S.S. Bearings	SCM
Type M.R. Bearings	716-06.01 or 716-07.01
Type E.L. Bearings	716-11
Type E.B. Bearings	716-12

**565-2.04 Protective Coatings**

- A. Machine finished surfaces in contact, including pins, pin holes, surfaces in sockets at the top of rocker bearings, and bronze or copper plates in sliding contact shall receive one coat of automotive grease as soon as machining is complete. None of these surfaces shall be painted.
- B. Stainless steel and polytetrafluoroethylene surfaces shall not be painted or otherwise coated.
- C. Metal to metal surfaces to be field welded shall be given a coat of clear lacquer or other protective coating approved by the Engineer, or Inspector, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. Painting, if required, will be done only after the completion of welding. Surfaces to be painted shall be primed and painted in accordance with §565-2.04D.
- D. All other metal surfaces shall be cleaned to meet SSPC-SP10, “Near-White Metal Blast Cleaning” and painted in accordance with section 572, Structural Paint System: Shop Applied. The paint shall be selected from the Department’s Approved List, Structural Steel Paints – Class 1. For bearings used in conjunction with unpainted steel, the color of the finish coat shall Weathered Brown as defined by §708-05.

**565-2.05 Shipping.** Each bearing shall be shipped as an assembled unit, except for elastomeric bearings. Elastomeric bearings may be shipped in packages containing more than one bearing, provided the package can be handled with normal construction equipment. Bearings shall be packaged in such a manner to protect all rotating and sliding surfaces from the intrusion of outside material. Bearings shall be packaged securely to prevent separation of the elements during shipping.

### **565-3 CONSTRUCTION DETAILS**

#### **565-3.01 Concrete Bearing Surface Elevations**

**A. General.** The elevation of the concrete bearing surface for all types of bearings, except Type M.R. bearings, shall be as given on the plans.

**B. Type M.R. Bearings.** The elevation of the concrete bearing surface may vary from that given on the plans depending on the vertical dimension of the actual bearing supplied. The Contractor shall notify the Engineer of all required elevation changes. Changes to the roadway profile will not be allowed. All elevation adjustments necessary to maintain the profile shall be made to the concrete bearing surfaces. Any adjustments, including changes to the reinforcement, will be made at no additional cost to the State.

**565-3.02 Concrete Bearing Surface Preparation.** No bearing shall be placed upon a concrete bearing surface which is deformed, irregular, or poorly finished. The entire bearing surface area shall be floated and troweled.

**565-3.03 Setting Anchor Studs.** Anchor studs shall be set as shown on the plans unless changes are permitted by the DCES. If anchor studs are cast in substructure concrete, templates, or other suitable means, shall be used to keep the studs vertical at the required embedment and in the correct horizontal position during concrete placement. If the Contractor elects to drill the finished, cured concrete in order to set the anchor studs, the reinforcing steel shall be positioned prior to casting the concrete so that it will not be damaged during drilling. If anchor studs are drilled and grouted, material and construction details shall be in conformance with §586-2 and §586-3.

**565-3.04 Bearing Pad Installation.** Bearing pads placed between concrete, or other masonry, and steel masonry plates shall be located to correct alignment and elevation, and placed at the time of masonry plate installation. Bearing pads shall conform to §728-01, §728-02, or §728-03 at the Contractor's option. Each bearing pad shall be the same size in plan as the masonry plate it supports. Holes to accommodate anchor studs shall be cleanly and accurately cut prior to bearing pad placement.

## 565-3.05 Bearing Installation and Alignment

### A. Type S.R. and Type S.S. Bearings

#### 1. General

- a. The centerline of sole plates or fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.
- b. The bearing shall be cleaned and regreased with automotive grease at the time of installation.

2. **Fixed.** No additional requirements apply.

3. **Expansion.** These may vary from perfect alignment. Therefore, expansion bearings shall be set in accordance with the following.

#### a. Type S. R. Bearings

- (1) The bearing shall be set vertical under full dead load at an ambient temperature of 68°F.
- (2) The maximum variation from perfect alignment is a function of the bearing height. The bearing height is the distance between the upper and lower contact surfaces of the movable portion of the bearing. For bearings with a height of 20 inches or less, the maximum variation from perfect alignment, taking into account the effect of temperature and load at the time of measurement, shall be calculated by the following formula:

$$M = \pm (1/2 \text{ inch} + (L/14,000) )$$

where “M” = maximum variation from perfect alignment measured as the horizontal distance between the centerline of the cap plate and the centerline of the masonry plate in inches and “L” = total expansion length in inches between the centerline of the movable bearing being considered and the centerline of the fixed bearing, from which motion must progress. Such variations shall not exceed 1 inch offset, or a five degree rotation of the movable portion of the bearings from the required alignment, whichever is less.

The maximum variation of all bearings having a height exceeding 20 inches shall be approved on an individual basis by the DCES.

- (3) No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

#### b. Type S. S. Bearings

- (1) The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.
- (2) The maximum variation from perfect alignment between the centerlines of the fixed and movable portions of the bearing device, taking into account the effect of temperature and load at the time of measurement, shall not exceed plus or minus 1/2 inch longitudinally. This variation shall be measured as the horizontal distance between the centerline of the sliding

plate and the centerline of the masonry plate. The movable portion of the bearing device shall be fully supported by the fixed portion under all temperature and loading conditions.

(3) No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

### ***B. Type M.R. Bearings***

**1. General.** The centerline of sole plates or other fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

**2. Fixed.** No additional requirements apply.

**3. Expansion.** These may vary from perfect alignment. Therefore expansion bearings shall be set in accordance with the following:

a. The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.

b. The maximum variation from perfect alignment between the centerline of the fixed and movable portions of the bearing device, taking into account the effects of temperature and load at the time of measurement, shall not exceed plus or minus 1 inch longitudinally unless otherwise indicated on the plans. This variation shall be measured as the horizontal distance between the centerline of the sliding plate and the centerline of the masonry plate.

c. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

### ***C. Type E.P. and Type E.L. Bearings***

#### ***1. General***

a. These bearings are designed to function properly provided that minimum distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Elastomeric bearings shall be installed when the ambient temperature is between 40°F and 80°F inclusive. The Contractor may elect to install the bearings when the ambient temperature is outside of the allowable range, provided the Contractor submits, and receives DCES approval, of an installation procedure that either resets the bearings when the temperature is in the allowable range or deforms the bearings so that they perform as if they were installed at 68°F.

b. For prestressed concrete superstructures, the bearing shall be anchored to establish the fixed end of the bridge as soon as possible after stringer erection. For adjacent prestressed box beams, or prestressed slab superstructures, the anchorage shall be completed prior to filling the shear keys. The method of anchorage shall be in accordance with the details shown on the plans. Anchor dowel holes shall be core drilled to the nominal size and depth and at the locations required by the plans. In lieu of core drilling, the Contractor may submit an installation procedure that incorporates the use of either preset anchor bolts or pipe sleeves to the DCES for

approval. Prior to placing the anchor dowel, the hole shall be inspected and approved for filling by the Engineer. Fill material shall be in accordance with the details on the plans.

**2. Fixed.** No additional requirements apply.

**3. Expansion**

- a. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.
- b. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

**D. Type E.B. Bearings**

**1. General**

- a. The centerline of sole plate or other fixed portions of bearing assemblies, attached to steel stringers, shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.
- b. These bearings are designed to function properly provided that minimal distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Elastomeric bearings shall be installed when the ambient temperature is between 40°F and 80°F inclusive. The Contractor may elect to install the bearings when the ambient temperature is outside of the allowable range, provided the Contractor submits, and receives DCES approval, of an installation procedure that either resets the bearings when the temperature is in the allowable range or deforms the bearings so that they perform as if they were installed at 68°F.

**2. Fixed.** No additional requirements shall apply.

**3. Expansion**

- a. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.
- b. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

**565-3.06 WELDING**

**A. Type S.R. Bearings.** Bearings shall be welded permanently to the structural steel only after all necessary adjustments have been made. All welding shall be done in accordance with the requirements of the SCM. The Contractor shall submit a Welding Procedure Specification to the

DCES. No welding shall be performed until the manufacturer receives an approved Welding Procedure Specification.

**B. Type S.S. Bearings.** The requirements of §565-3.06A shall apply.

**C. Type M.R. Bearings.** The requirements of §565-3.06A shall apply except that during field welding operations the temperature of the steel adjacent to the rotational element shall not exceed 200°F. Temperature shall be controlled by welding procedures and monitored using temperature indicating crayons, or other devices. Procedures, crayons, and other devices shall be acceptable to the Engineer. If the temperature limit is exceeded, the DCES and the Director, Materials Bureau shall be immediately notified. The DCES will provide the proper repair procedure, which may include complete replacement of the bearing. All repair work shall be done at no additional cost to the State.

**D. Type E.B. Bearings.** The requirements of §565-3.06A and §565-3.06C shall apply.

**565-3.07 Grouting Anchor Bolt Holes.** All slotted anchor bolt holes in masonry plates shall be filled with concrete grouting material to the top edge of the hole. All excess grout material shall be cleaned from the bearing surfaces in a manner satisfactory to the Engineer. Slotted anchor bolt holes in fixed bearings may be filled any time subsequent to stringer placement. Slotted holes in expansion bearings shall be filled only after all necessary bearing adjustments have been made.

**565-3.08 Final Verification.** Prior to final acceptance of the bridge, the Engineer will verify that all necessary adjustments have been made; that all steel bearings, or external load plates, are permanently welded or attached with cap screws to the superstructure steel as shown on the contract plans; that all slotted holes are completely filled with grout; that all anchor studs are firmly tightened; and that all other work required to make the bearings completely functional has been completed.

**565-4 METHOD OF MEASUREMENT.** Measurement will be taken as the number of bearings installed in accordance with the Contract Documents.

**565-5 BASIS OF PAYMENT.** The unit price bid for each bearing shall include the cost of all labor, materials, equipment and adjustment necessary to complete the work. All material between the bottom of the superstructure, and the top of the substructure, including anchor studs and sole plates, shall be included in the price bid for this item.

**565-5.01 Progress Payments.** Eighty percent of the quantity will be paid for after the bearing is installed. The remainder of the quantity will be paid for after the bearing is aligned.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
565.1121	Type S.R. Expansion Bearing (All Load Ranges)	Each
565.1221	Type S.R. Fixed Bearing (All Load Ranges)	Each
565.1321	Type S.S. Expansion Bearing (All Load Ranges)	Each
565.1421	Type S.S. Fixed Bearing (All Load Ranges)	Each
565.1521	Type M.R. Expansion Bearing (0 to 225 k)	Each
565.1522	Type M.R. Expansion Bearing (226 to 450 k)	Each
565.1523	Type M.R. Expansion Bearing (451 to 675 k)	Each
565.1524	Type M.R. Expansion Bearing (676 to 900 k)	Each
565.1525	Type M.R. Expansion Bearing (Over 900 k)	Each
565.1721	Type M.R. Fixed Bearing (0 to 225 k)	Each

565.1722	Type M.R. Fixed Bearing (226 to 450 k)	Each
565.1723	Type M.R. Fixed Bearing (451 to 675 k)	Each
565.1724	Type M.R. Fixed Bearing (676 to 900 k)	Each
565.1725	Type M.R. Fixed Bearing (Over 900 k)	Each
565.1821	Type E.P. Bearing (All Load Ranges)	Each
565.1921	Type E.L. Bearing (0 to 55 k)	Each
565.1922	Type E.L. Bearing (56 to 111 k)	Each
565.1923	Type E.L. Bearing (112 to 168 k)	Each
565.1924	Type E.L. Bearing (169 to 225 k)	Each
565.1925	Type E.L. Bearing (Over 225 k)	Each
565.2021	Type E.B. Fixed Bearing (0 to 55 k)	Each
565.2022	Type E.B. Fixed Bearing (56 to 111 k)	Each
565.2023	Type E.B. Fixed Bearing (112 to 168 k)	Each
565.2024	Type E.B. Fixed Bearing (169 to 225 k)	Each
565.2025	Type E.B. Fixed Bearing (Over 225 k)	Each
565.2031	Type E.B. Expansion Bearing (0 to 55 k)	Each
565.2032	Type E.B. Expansion Bearing (56 to 111 k)	Each
565.2033	Type E.B. Expansion Bearing (112 to 168 k)	Each
565.2034	Type E.B. Expansion Bearing (169 to 225 k)	Each
565.2035	Type E.B. Expansion Bearing (Over 225 k)	Each
565.30	Rubber Impregnated Woven Cotton-Polyester Fabric	Each

## SECTION 566 - MODULAR EXPANSION JOINT SYSTEMS

(Last Revised January, 2021)

**566-1 DESCRIPTION.** The work shall consist of fabricating, furnishing, and installing a modular expansion joint system at the locations indicated on the Contract Plans.

**566-1.01 Modular Joint Systems.** Modular expansion joint systems are manufactured in various sizes, defined by their total movement capability. The correct movement capability required at any one location is indicated on the Contract Plans.

**566-1.02 Sealing Elements.** On each individual structure, all the seals used in the modular joints shall be of the same configuration and shall be from the same manufacturer.

### 566-1.03 Modular Joint System Suppliers

**A. Multicell Modular Joint Systems.** Only firms which appear on the Department's Approved List will be acceptable suppliers. No supplier other than those listed will be considered.

**B. One Cell Modular Joint Systems.** Firms that do not appear on the Department's Approved List may supply one cell Modular Joint Systems. Firms which appear on the Department's Approved List will also be acceptable suppliers.

**566-1.04 Terminology.** The following terminology will be used throughout this section:

**A. Joint System.** This term is used to describe the installation with all of its component parts as installed in the structure slab, and if applicable in sidewalks, barriers and other bridge components.

**B. Segment.** A modular joint system manufactured at less than full roadway width. No segment shall be less than a single lane width long.



**C. Joint.** The separation between two elements of a bridge to allow for movement.

**566-2 MATERIALS.** Materials shall conform to the following requirements.

**566-2.01 Modular Joint System.** The modular joint system and all its component parts, including stiffening plates and anchorages, shall be supplied by the Manufacturer. The Manufacturer shall certify that the following components meet the listed requirements:

Hollow Beams, Steel Extrusions and Milled Steel Shapes	ASTM A588
Box Seals	705-09 <sup>1</sup>
Strip Seal	ASTM D2628 <sup>2</sup>
Adhesive	567-2.02
Stud Shear Connectors and Threaded Studs	709-05
Cover Plates – 3/8 inch Thickness	ASTM A36 <sup>3</sup>

**NOTES:**

- 1 . Shape approval by the Director of Materials is not required. Hardness, Type A Durometer shall be 60 ± 5; ASTM Method D2240. A 3-foot sample of the seal shall be submitted for testing to the Materials Bureau. No splices shall be permitted in permanent seals for any reason whatsoever.
- 2 . Recovery test not required.
- 3 . Cover Plates shall be Galvanized in accordance with §719-01, Type I.

**566-2.02 Shop Drawings**

A. Shop Drawings shall be required for any joint system supplied as part of this work. Shop Drawings shall be prepared and reviewed in accordance with the applicable provisions of the SCM and this Specification and submitted to the DCES for approval. All Shop Drawings shall note the name and address of the Joint System Fabricator, including the actual location (address) where the fabrication will take place.

B. The Modular Joint System Manufacturer's instructions for the proper installation of the joint system shall be included on the Shop Drawings. Manufacturer's instructions shall include the proper width settings for various ambient temperatures. Shop Drawings which lack Manufacturer's installation instructions will be returned without examination.

C. Filler metal shall be qualified in accordance with Section 7 of the SCM. Welding Procedure Specifications (WPS) shall be submitted for approval to the DCES with the Shop Drawings for each combination of joint type and welding process shown on the Shop Drawings. Shop Drawing Approval will be withheld until this requirement has been met.

**566-2.03 Fabrication**

A. All steel fabrication (shop and field) shall be done in accordance with the requirements of the SCM. Mill inspection of the steel will not be required.

B. All metal surfaces in contact with the neoprene sealer shall be blast cleaned in accordance with the requirements of Steel Structures Painting Council Surface Preparation No. 6 (SSPC-SP6) - Commercial Blast Cleaning. After cleaning, all cleaned surfaces shall exhibit a clean quality of CSP6, or better, as defined by Steel Structures Painting Council Standard SSPC Vis 1.

C. The cleaned metal surfaces shall be protected from rusting until such a time as the sealer, and lubricant adhesive are placed against the metal surface. Any cleaned metal surface upon which rusting appears shall be recleaned in accordance with the foregoing, at no additional expense to the State.

D. When a cover plate is required, the modular joint shall be fabricated accounting for the necessary recess to create a flush mounted plate.

E. Unless otherwise noted, each modular expansion joint system shall be fabricated as a single entity. It shall fit the full width of the structure as indicated on the Contract Plans. The system shall be preset by the Manufacturer prior to shipment. Presetting shall be done in accordance with the joint opening at 68°F. The joint opening will be indicated on the Contract Plans. Should the plans indicate that segmental fabrication is permissible, or required, each segment shall be fabricated to exactly fit that portion of the superstructure under construction, including sidewalks. Segments shall be fitted with temporary seals. Temporary seals will not require lubricant adhesive.

F. Shop inspection will be conducted at the discretion of the Department.

**566-2.04 Acceptance.** The fabricated joint system will be accepted at the work site by the Engineer after a visual inspection and upon receipt of the Manufacturer's Certification Report (MCR) that the materials and the fabricating procedures were in accordance with the Approved Shop Drawings and this Specification. The Manufacturer shall submit, with the MCR, a Certified Copy of the Mill Test Report (MTR) for all steel used to fabricate the joint system.

### **566-3 CONSTRUCTION DETAILS**

**566-3.01 Manufacturer's Representative.** During the initial stages of the joint system installation the Contractor shall have present at the installation site a Representative of the Joint System Manufacturer. This person shall be competent in all respects regarding the proper installation procedures to be used. The Representative shall advise the Contractor of, and certify to the Engineer that, the proper procedures are being followed. All certifications to the Engineer shall be in writing. A Manufacturer's Representative is not required for One Cell Modular Joint Systems.

**566-3.02 Field Inspection.** Immediately prior to installation, the joint system shall be inspected by the Engineer, for proper alignment, and complete bond between the neoprene sealer and the steel, and proper stud placement and effectiveness. No bends or kinks in the joint system steel shall be allowed (except as necessary to follow the roadway profile and grades). Nor shall the straightening of such bend or kinks be allowed. Any joint system exhibiting bends or kinks shall be removed from the work site, and replaced by a new joint system, at no additional cost. Neoprene sealer not fully bonded to the steel shall be fully bonded at the expense of the Contractor. Studs shall be inspected visually and shall be given a light blow with a hammer. Any stud which does not have a complete end weld or does not emit a ringing sound when struck by a light blow with a hammer, shall be replaced. Studs located more than 1 inch, in any direction, from the location shown on the Shop Drawings, shall be carefully removed and a new stud placed in the proper location. All stud replacements shall be at no additional cost.

#### **566-3.03 Installation**

**A. Manufacturer's Instructions.** The modular expansion joint system shall be installed in strict accordance with the Manufacturer's instructions, and the advice of their Official Representative. Two weeks prior to the intended installation, the Engineer shall be supplied with two copies of the written instructions. The permanently installed joint system shall match exactly the finished roadway profile and grades. The words "permanently installed", shall be interpreted to mean that any work necessary to be done to any other part of the structure, in order to achieve a truly complete permanent installation, has been done. This will apply even if the other work is to be paid for under other items of the Contract.

**B. Joint System Width, Splices, and Installation Equipment.** The modular expansion joint system shall be set to the proper width for the ambient temperature at the time of setting, as indicated on the Shop Drawings. If the joint system has been fabricated in segments, they shall be field spliced to create a single unbroken system.

All mechanical devices, supplied by the Joint System manufacturer, used to set the joint system to the proper width, will remain the property of the Manufacturer. When no longer required, the devices shall be returned to the Manufacturer.

**C. Cover Plate.** In order to perform the work of installing the joint systems in a proper manner, some portions of the curb and parapet cannot be constructed until after the cover plates of the joint system are installed. This surface shall be scrubbed with wire brooms. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Construction joints must be wetted by continuous spraying with hoses using potable water. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete.

**In lieu of wetting, the Contractor may elect to coat the area of contact with a penetrating sealer per §717-03.** The surface shall be allowed to dry for 24 hours before coating. All surface preparation work shall be completed before sealer application can commence. There is no time limit between coating with sealer and placing the new concrete. If the area becomes contaminated in any way, it shall be cleaned prior to placing the new concrete.

**D. Permanent Seals.** After the joint system has been completely installed over the full width of the structure, including sidewalks, the temporary seals shall be removed and replaced with permanent seals. After the temporary seals are removed, all metal surfaces which will be in contact with the permanent seals shall be commercially blast cleaned (SSPC-SP6) to visual standard CSP6 as defined by SSPC Vis 1-89.

**E. Final Placement.** After the modular joint system has been set to its final line and grade, the recess opening shall be filled with the same concrete used for the slab. This surface shall be scrubbed with wire brooms. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Construction joints shall be wetted by continuous spraying with hoses using potable water. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete. The uppermost surface of the concrete placement shall be finished in accordance with the requirements of Section 557 except that machine finishing will not be required and the curing time is seven days. The cost of this work shall be included in the unit price bid for the slab item(s).

**In lieu of wetting, the Contractor may elect to coat the area of contact with a penetrating sealer per §717-03.** The surface shall be allowed to dry for 24 hours before coating. All surface preparation work shall be completed before sealer application can commence. There is no time limit between coating with sealer and placing the new concrete. If the area becomes contaminated in any way, it shall be cleaned prior to placing the new concrete.

**F. Watertight Integrity Test.** After the joint system has been permanently installed, including cover plates and all concrete placements, a watertight integrity test shall be performed. The test shall be done in accordance with the requirements of §567-3.01 H.

**566-4 METHOD OF MEASUREMENT.** The work will be measured as the number of feet of joint system completely installed. Measurement will be taken horizontally and vertically along the centerline of

the joint system between the outer limits indicated on the Contract Plans. The words “completely installed” shall be interpreted to mean the joint system in-place with the following operations completed, where applicable:

Nuts tightened, or retightened, as required.

Concrete placed, finished, and curing completed.

Watertight integrity tests performed.

### **566-5 BASIS OF PAYMENT**

**566-5.01.** The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work.

**566-5.02.** No payment will be made for any work noted to be done at the expense of the Contractor, or any work noted to be paid for under other items of the Contract.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
566.01	Modular Expansion Joint System - One Cell	Foot
566.02	Modular Expansion Joint System - Two Cell	Foot
566.03	Modular Expansion Joint System - Three Cell	Foot
566.04	Modular Expansion Joint System - Four Cell	Foot
566.05	Modular Expansion Joint System - Five Cell	Foot
566.06	Modular Expansion Joint System - Six Cell	Foot

### **SECTION 567 - BRIDGE JOINT**

(Last Revised January, 2021)

**567-1 DESCRIPTION.** The work shall consist of furnishing and installing bridge joints. The bridge joint required will be indicated on the contract plans.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all bridge joints in accordance with §106-01 Sources of Supply.

**567-1.01 Bridge Joints.** There are various kinds of bridge joints. Those included as part of the work required by this section are:

**A. Armored Joint with Elastomeric Sealer.** The joint shall consist of armored joint segments, angles, anchor studs, threaded studs, bolts, nuts, lock washers, expansion bolt anchors, cover plates, and sealant, all combined as noted in the contract documents so that the joint is fully operational and waterproof.

**B. Armored Joint with Compression Seal.** This joint shall consist of angles, preformed compression seal, cover plates, anchor studs, threaded studs, bolts, nuts, lock washers all combined as noted in the contract documents so that the joint is fully operational and waterproof. The joint shall provide for the full expansion and contraction movements of the joint.

This joint shall be fabricated as a single entity designed to be installed across the full width of the bridge as measured along the centerline of joint. If the bridge in question has a raised median, one field splice of the joint will be allowed at the raised median.

**Type.** Preformed compression seals are manufactured in various type sizes, defined by a literal-numerical type designation (e.g. Type A1, etc.). The type of seal to be installed in any single armored joint will be indicated on the contract plans.

**C. Armored Joint with Preformed Elastic Strip Seal.** This joint shall consist of structural steel components, angles, anchor studs, threaded studs, bolts, nuts, washers, lock washers, anchor bolts, cover plates, preformed elastic strip seal and adhesive, all combined in the manner required by the Contract Documents so that the joint is fully operational and waterproof. Armored joints are installed by various methods. The required method will be indicated on the Contract Plans.

**Type.** Preformed elastic strip seals are manufactured in various sizes, defined by a type number. The type of strip seal to be installed will be indicated on the Contract Plans.

**D. Armorless Bridge Joint.**

The joint shall consist of a header and a seal. Headers and seals each appear independently in the Materials Bureau Approved List and the installation of each is shown on an Approved Materials Detail Sheet. A joint includes cover plates when required by Contract Documents.

**567-1.02 Terminology.** The following terminology will be used throughout this section:

**A. Armored Joint.** This term is used to describe the joint with all of its component parts as installed in the structure slab. Terminology used to differentiate one kind of joint from another will be found in the title of the various subsections (e.g. 567-2.01 Armored Joint with Elastomeric Sealer, etc.)

**B. Segment.** A joint manufactured at less than full roadway width. No segment shall be less than a single lane width long.

**C. Joint.** The separation between two elements of a bridge structure to allow for movement.

**D. Materials Detail Sheet (MDS).** A sheet containing all material requirements and installation information for Armorless Bridge Joint components which are included on the Materials Bureau Approved List.

**567-2 MATERIALS.** Material and Fabrication requirements shall be as described below for the various bridge joints.

**567-2.01 Armored Joint with Elastomeric Sealer**

Elastomer (Polychloroprene or Natural Rubber)	Table 567-1 Elastomer Material
Structural Steel Segment Angles	ASTM A242 and 715-01, or ASTM A36
Headed Concrete Anchor Studs and Threaded Studs	§709-05
Reinforcing Bars	§556-2
Bolts, Nuts and Washers Steel	ASTM A307 Grade A or ASTM F3125 GRADE
A325	
Expansion Bolt Anchor Steel	U.S. Government GSA FF-S-325
	Group III, Type 1 or Group VIII, Type 1
Cover Plates <sup>1</sup> 3/8 inch Thickness	ASTM A36
Bonding Tape <sup>2</sup>	Fed. Spec MIL C 18969a, Type II, Class B polyisobutylene-based extrusion, with aggressive tack

1. Cover Plates shall be Galvanized per §719-01, Type I.
2. Used to bond end surfaces of the preformed elastomeric joint sealer to each other.

**A. Physical Composition.** Armored segments shall be comprised of elastomer or natural rubber, and structural steel components in the manner indicated on the contract plans.

**B. Length.** Armored segments shall be furnished in lengths not less than a single lane width, excluding length of tongues. Shorter lengths may be used at locations requiring special treatment or to provide the closing sections.

**C. Steel Fabrication.** All steel fabrication work shall be done in accordance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.

**D. Cleaning.** The surface of the armored joint segment, to which the preformed elastomer is to be heat bonded, shall be thoroughly cleaned of all dirt, oil, grease, scale and oxides by grinding or sandblasting immediately prior to the heat bonding process. The metal surface after cleaning, shall be defined by SSPC Vis 1-89 Pictorial Standard, and shall meet the requirements of SSPC-SPC-6, Commercial Blast Cleaning, but shall not be of a quality less than CSP6.

<b>TABLE 567-1 ELASTOMER MATERIAL REQUIREMENTS</b>			
<b>Property</b>	<b>ASTM Test</b>	<b>Polychloroprene</b>	<b>Natural Rubber</b>
Tensile Strength	D412	1800 psi	2250 psi
Tensile Elongation at break	D412	400 percent minimum	400 percent minimum
Hardness, Shore A Durometer	D2240	45 (±5)	50 (±5)
Compression Set (22 hrs at 158°F)	D395 Method B	20 percent maximum	20 percent maximum
Low Temperature	D746 Procedure B	Not brittle at -40°F	Not brittle at -65°F
Oil Deterioration (Volume increase after immersion in ASTM Oil No. 3 for 70 hrs @ 212°F)	D471	120 percent maximum	Not Applicable

**E. Basis of Acceptance.** All materials used for this item, regardless of whether they are employed for fabrication or installation, shall be accepted at the work site upon certification, by the proper manufacturer, that all requirements of the contract documents have been met.

### **567-2.02 Armored Joint with Compression Seal**

Compression Seal	705-09 <sup>1</sup>
Angles, Plates and Bars (Structural Steel)	ASTM A242, A588 <sup>2</sup> , 715-01 and SCM
Headed Concrete Anchor Studs and Threaded Studs	§709-05
Bolts, Nuts and Washers	ASTM A307 Grade A or ASTM F3125
GRADE A325	
Support Bar for the compression seal	ASTM A242, AISI 1018 or AISI 1020 <sup>3</sup>
Cover Plates <sup>4</sup> – 3/8 inch Thickness	ASTM A36
Expansion Bolt Anchors	U.S. Government GSA FF-S-325 Group III, Type 1 or Group VIII, Type 1

Adhesive<sup>5</sup>

Table 567-2 Moisture Curing Urethane

NOTES:

1. The sealer shall be applied in one piece for the full length of each joint. Splices will not be permitted if the full length of joint is less than 50 feet. If the full length of joint is more than 50 feet, but less than 100 feet long, one shop splice in the sealer will be permitted. If the full length of joint is greater than 100 feet, shop splices in the sealer will be permitted at approximately 50 foot intervals.
2. Support angles may be ASTM A36
3. If AISI 1018 or AISI 1020 steel is used it shall be painted in accordance with the requirements of the contract documents.
4. Cover Plates shall be galvanized per §719-01, Type 1.
5. Used to bond the preformed seal to the steel surface.

TABLE 567-2 MOISTURE CURING URETHANE	
Average weight per gallon	8 lbs ± 10%
Solids Content	72% - 74% by Weight
Adhesive to remain fluid, from	5°F to 120°F
Film Strength (ASTM D412)	1200 psi
Elongation	350%

**A. Assembly.** The joint shall be shop assembled and delivered to the work site ready for installation. If the Contractor desires to assemble the joint at the work site, prior permission to do so must be obtained from the DCES.

Joint assembled at the work site shall have all materials certified by the respective manufacturers that the respective materials meet the requirements of §567-2.02. Field methods of fabrication shall be in accordance with the requirements of this subsection.

**B. Procedures.** Steel fabrication shall be done in conformance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.

**C. Cleaning.** Metal surfaces which are to be coated with adhesive shall be cleaned in accordance with Steel Structures Painting Council, Surface Preparation No. 6, Commercial Blast Cleaning (SSPC SP6) with the following modifications and additions:

1. The cleaned surfaces shall have adhesive applied before detrimental rusting occurs.
2. A commercial blast cleaned surface shall be as defined by SSPC SP6 and SSPC Vis 1-89 pictorial references BSP6 and CSP6 only.

**D. Basis of Acceptance.** The armored joint with preformed compression seal will be accepted at the work site upon certification to the Engineer by the Contractor, that the materials used and the fabricating procedures were in accordance with this specification.

The certification shall include the name of the sealer manufacturer, the lot numbers of all sealers used in the fabrication of the armored joint and the statement that all sealer used in the fabrication of the armored joint was appropriately identified as accepted materials by the presence of Department security seals when received by the fabricator.

**567-2.03 Armored Joint with Preformed Elastic Strip Seal.** Since there are various methods of installing the joint, all of the materials listed in this Subsection may not be applicable for an installation. It is the Contractor's responsibility to ensure that only those materials necessary are required, or as specified on the Approved Shop Drawings, are installed.

Angles, Plates, Extrusions and Milled Shapes

ASTM A588 and §715-01

Headed Concrete Anchor Studs and Threaded Studs	§709-05
Bolts and Nuts	ASTM A307 or F3125 GRADE A325.
Anchor Bolts	ASTM A307 Grade A
Anchor bolt grout	§701-07
Preformed Elastic Strip Seal	ASTM D2628 modified <sup>1</sup>
Adhesive	Table 567-2, Moisture Curing Urethane
Concrete <sup>2</sup>	§501, Class HP or §557 Class HPIC
Elastomeric Concrete <sup>2</sup>	Contract Documents
Cover Plates – 3/8 inch Thickness	ASTM A36 <sup>3</sup>

**NOTES:**

1. Recovery Test is not required. The sealer shall be supplied in one piece for the full length of each joint.
2. Concrete and Elastomeric Concrete, when used, shall be placed and paid under a separate item.
3. Cover Plates shall be galvanized per 719-01.

**A. Steel Fabrication.** Steel fabrication shall be done in conformance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.

**B. Cleaning.** Metal surfaces which are to be coated with adhesive shall be thoroughly cleaned of all dirt, oil, grease, scale and oxides by grinding or sandblasting. Metal surfaces after cleaning shall exhibit a clean quality of CSA2, or better, as defined by the Steel Structures Painting Council Standard SSPC Vis1.

**C. Adhesive Coating.** The recess of the steel extrusions shall be thoroughly coated with adhesive. The strip seal shall be installed within the recess in such a manner that it will be completely and firmly bonded to the recess surface over the total length of the joint.

**D. Basis of Acceptance.** The fabricated joint will be accepted at the work site by the Engineer after a visual inspection and upon receipt of the Manufacturer's Certification Report (MCR) that the materials and the fabricating procedures were in accordance with the Approved Shop Drawings and this Specification. The Manufacturer shall submit, with the MCR, a Certified Copy of the Mill Test Report (MTR) for all steel used to fabricate the joint.

**567-2.04 Armorless Bridge Joint.** The material requirements shall be as shown on the Approved Materials Detail Sheet corresponding to a Manufacturer and Component listed on the Materials Bureau Approved List.

Preformed Closed-Cell Foam Material	705-08
Foam Supported Silicone.	705-23
Preformed Seals	705-09
Elastomeric Concrete	701-11

**567-2.05 Shop Drawings.** Shop drawings will be required for any armored joint supplied as part of this work. All shop drawings shall note the name and address of the joint (or segment) fabricator as well as the location where the joint or segments, are to be fabricated. The applicable provisions of Section 2-Drawings, of the New York State Steel Construction Manual shall apply with the following modifications



**A. Shop Drawings.** Shop drawings shall be submitted for review, approval and distribution in accordance with the requirements of the SCM, Section 2. The shop drawings shall indicate the type, location and details of the mechanical devices required to compress the joint to its required width based on the ambient temperature at the time of installation. All references, within Section 2 to the DCES, shall be interpreted as the Regional Director, with the following exceptions:

- 202.9 - Distribution of Approved Shop Drawings.

**B. Welding Procedure Specifications.** The Contractor shall submit with the shop drawings a Welding Procedure Specification (WPS), approved by the DCES for each combination of joint type and welding process shown on the shop drawings.

The WPS approval date shall be within 36 months of the joint fabrication date. A submitted WPS showing an approval date earlier than 36 months prior to joint fabrication will be rejected and the Contractor shall be required to submit shop drawings accompanied by a currently approved WPS(s). No extension of time, nor additional payment will be forthcoming for delays caused by the Contractor's failure to submit current WPS(s).

**567-3 CONSTRUCTION DETAILS.** The construction details shall be as required for the various bridge joints and the approved shop drawings.

#### **567-3.01 Armored Joint with Elastomeric Sealer**

**A. Manufacturer's Representative.** The joint shall be installed in strict accordance with the manufacturer's instructions and this subsection. In the event of a conflict, the terms of this subsection shall rule. A representative of the manufacturer shall be present at the beginning of the installation. The representative shall be fully conversant in all respects with the correct installation methods. The representative shall be responsible to advise both the Engineer and the Contractor, that the proper installation method is being followed.

**B. Preparation.** The preformed recess which is to receive the joint shall be air blown or vacuum-cleaned to remove all loose or foreign matter prior to installation of the joint.

**C. Storage Inspection and Handling.** The joint shall be stored, inspected and handled in accordance with the following:

**1. Handling and Storing.** All material shall be handled and stored in a manner approved by the Engineer, and consistent with the requirements of the SCM. No material shall be dropped, thrown, or dragged upon the ground. Material shall be kept clean, properly drained and stored on proper supports above the ground. All material shall be adequately shored, braced, or clamped to resist lateral forces which might occur. Permanent distortion will be cause for rejection of material.

If the shop applied protective coating deteriorates to the point that the Engineer considers it unacceptable, the contractor shall restore the shop applied coating to a condition acceptable to the Engineer. This work shall be done before other coatings are applied. The work shall be done in accordance with the requirements of the contract documents.

**2. Field Inspection.** All installation work shall be subject to the Engineer's inspection. The Engineer shall be given all facilities required for a thorough inspection. Materials and workmanship subject to shop inspection shall be identified by the acceptance stamp of the Shop Inspector. Materials and workmanship not required to be shop inspected will be inspected by the Engineer. Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of 715-01.

**D. Installation Inspection.** Immediately prior to installation, the armored segments shall be inspected by the Engineer for proper alignment and complete bond between the polychloroprene and the steel, and proper stud placement and effectiveness. No bends or kinks in the armoring steel shall be allowed, nor shall straightening of such bends or kinks be allowed. Armored segments exhibiting bends or kinks shall be removed from the work site and replaced with new armored segments at the Contractor's expense. Armored segments which exhibit any separation of the polychloroprene and the armoring steel shall be removed from the work site and replaced with new armored segments at the Contractor's expense. Studs shall be inspected visually and shall be given a light blow with a hammer. Any threaded stud which does not have a complete end weld or does not emit a ringing sound when struck a light blow with a hammer shall be replaced. Studs located more than 1 inch from the location shown on the shop drawings shall be carefully removed and a new stud placed in the proper location.

**E. Mechanical Devices.** To install the armored segments properly, they must be set at a width which is directly dependent upon the ambient temperature at the start of installation, as shown on the shop drawings. The width setting shall be accomplished by using mechanical devices supplied by the armored segment fabricator. After the armored segment has been set to its proper line and grade and securely attached to its supports, the mechanical devices shall be removed and returned to the armored segment manufacturer.

**F. Sealing Segment Surfaces.** The mating surfaces of the armored segments shall be scrubbed with wire brushes, or other means satisfactory to the Engineer, to remove any rust from the steel and roughen the polychloroprene. This operation shall immediately precede the application of tape to the mating surfaces.

**G. Concrete Placement and Finishing.** After the joint has been fully installed, concrete shall be placed in accordance with the contract plans. The concrete shall be finished in accordance with 557-3.07 - Finishing Integral Wearing Surfaces on Superstructure Slabs.

**H. Watertight Integrity Test** At least five workdays after the joint has been fully installed the Contractor shall test the entire (full length) joint for watertight integrity employing a method satisfactory to the Engineer. The entire joint shall be covered with water, either ponded or flowing, for a minimum duration of 15 minutes. Rain is acceptable as a water source. The concrete surfaces under the joint shall be inspected, during this 15 minute period and also for a minimum of 45 minutes after the supply of water has stopped, for any evidence of dripping water or moisture. Water tightness shall be interpreted to be no free dripping water on any surface on the underside of the joint. Patches of moisture shall not be cause for non-acceptance.

Should the joint exhibit evidence of water leakage at any place whatsoever, the Contractor shall locate the place(s) of leakage and take all measures necessary to stop the leakage. This work shall be done at the Contractor's expense. A subsequent water integrity test shall be performed subject to the same conditions and consequences as the original test.

### **567-3.02 Armored Joint with Compression Seal**

**A. Delivery.** The joint shall be delivered to the work site ready for installation in accordance with the requirements of 567-2.02B1.

**B. Preparation.** The requirements of 567-3.01B, shall apply.

**C. Storage Inspection and Handling.** The requirements of 567-3.01C shall apply.

**D. Installation Inspection.** The armored joint with compression seal shall be inspected in the same manner as required for armored segments under 567-3.01D. All the requirements of 567-3.01D shall apply, except that compression seal not fully bonded to the armoring angles will not mandate replacement of the joint. However, any compression seal which is not fully bonded, shall be fully bonded to both armoring faces, by the Contractor, at no expense to the State.

**E. Mechanical Devices.** The requirements of 567-3.01E shall apply.

**F. Concrete Placement and Finishing.** The requirements of 567-3.01G shall apply.

**G. Watertight Integrity Test.** The requirements of 567-3.01 H shall apply.

### **567-3.03 Armored Joint with Preformed Elastic Strip Seal**

**A. Site Delivery.** The joint shall be shop assembled and delivered to the work site ready for installation, unless prior permission to field assemble has been granted by the Engineer.

**B. Field Assembly.**

1. If the Contractor desires to assemble the joint at the work site, prior permission to do so shall be obtained from the Engineer, in writing.
2. Joints assembled at the work site shall have all materials certified by the respective Manufacturers. The certifications shall state that the Materials requirements of this Specification have been met.

**C. Storage Inspection and Handling.** The requirements of 567-3.02C shall apply.

**D. Installation Inspection.** The requirements of 567-3.02D shall apply. The term “compression seal” shall be interpreted as “preformed elastic strip seal.”

**E. Mechanical Devices.** The requirements of 567-3.01E shall apply.

**F. Recess Finishing.** If the joint is installed within a preformed concrete or asphalt recess, the recess will be filled and finished to grade with either structural concrete or elastomeric concrete. The exact materials will be indicated on the Contract Plans. The respective materials will be installed in the following manner:

**1. Concrete.** Placement shall be in accordance with 555. Finishing shall be done in accordance with 557-3.07. Machine finishing will not be required.

**2. Elastomeric Concrete.** Placement shall be in accordance with §701-11.

**G. Watertight Integrity Test.** The requirements of 567-3.01 H shall apply.

### **567-3.04 Armorless Bridge Joint**

**A. Manufacturer's Representative.** The joint shall be installed in strict accordance with the manufacturer's instructions and the Approved Materials Detail Sheet for each component. In the event of a conflict, the terms of the Approved Materials Detail Sheet shall rule. A representative of each bridge joint component manufacturer shall be present prior to placement to inspect the prepared surfaces and remain at the job during all phases of the installation. The requirement will be waived

for a Contractor who has experience installing that component and uses the individual who has the experience performing the work. The representative shall be fully conversant in all respects with the correct installation methods. The representative shall be responsible to advise both the Engineer and the Contractor on the proper installation of the joint. The representative may be excused from the project site at the discretion of the Engineer.

**B. Preparation.** All surfaces shall be prepared as per the Approved MDS. At a minimum, the preformed recess which is to receive the joint shall have the surface roughened to remove any laitance and be air blown using air free of water and oil or vacuum-cleaned so that all loose or foreign matter is removed prior to installation of the joint. The substrate shall be dry for a minimum of 24 hours prior to installation for the joint.

The joint header material shall be installed as per manufacturers recommendations. The header surfaces which will be in contact with the joint seal shall be vertical, parallel, at the same elevation across the joint, and be within 1/8” of the opening dimension shown on the contract plans.

**C. Storage Inspection and Handling.** The joint components shall be stored, inspected and handled in accordance with the Approved Materials Detail Sheet.

**D. Installation Inspection.** All installation work shall be subject to the Engineer's inspection.

**E. Watertight Integrity Test.** The requirements of 567-3.01 H shall apply.

**567-4 METHOD OF MEASUREMENT.** Measurement for each joint will be made as the number of feet of joint completely installed, measured horizontally and vertically along the centerline of joint between the outer limits as indicated on the contract plans.

The words “completely installed” shall be interpreted to mean the joint in place with the following operations completed where applicable:

- All sealant in its proper position.
- All nuts tightened or retightened as required.
- Concrete placed and finished.
- Header concrete placed and finished.
- Water-tight integrity tests.

Measurement for seals will be made as the number of feet of Bridge Joint Seal completely installed, measured along the longitudinal axis of the seal.

Measurement of Bridge Joint headers will be made as the volume of material installed measured to the nearest cubic foot.

**567-5 BASIS OF PAYMENT.** The unit price bid per foot shall include all labor, materials and equipment necessary to complete the work. No additional payment will be made for corrective actions.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
567.31	Armored Joint with Compression Seal-Type A1	Foot
567.32	Armored Joint with Compression Seal-Type A2	Foot
567.33	Armored Joint with Compression Seal-Type A3	Foot
567.34	Armored Joint with Compression Seal-Type A4	Foot
567.35	Armored Joint with Compression Seal-Type A5	Foot
567.36	Armored Joint with Compression Seal-Type A6	Foot

567.37	Armored Joint with Compression Seal-Type A7	Foot
567.50	Armored Joint with Preformed Elastic Strip Seal - Type as Noted	Foot
567.60	Armorless Bridge Joint	Foot
567.62	Bridge Joint Header	Cubic Foot
567.63	Bridge Joint Seal	Foot

## SECTION 568 - BRIDGE RAILING

**568-1 DESCRIPTION.** This work shall consist of furnishing and erecting bridge railing as shown on the contract plans and in accordance with the specifications.

As soon as the Contract is awarded, the Contractor shall notify the DCES of the name and address of the Fabricator of all bridge railing in accordance with §106-01 Sources of Supply. This notification shall list the specific shop or shops in which the railing will be fabricated.

**568-2 MATERIALS.** Materials shall meet the requirements of the following subsections:

Concrete Grouting Material	701-05
Steel Bridge Railing	710-23
Stainless Steel Connecting Products	715-16
Rubber Impregnated Random Fiber Pad	728-02

### 568-3 CONSTRUCTION DETAILS

#### 568-3.01 Erection of Railing

**A. Inspection of Railing.** Immediately prior to erection, the railing shall be inspected for damage. Significant bends or kinks in the railing not specifically called for in the contract documents shall constitute sufficient cause for rejection. Straightening of such bends or kinks shall not be allowed.

Bending or curving rails in the field in order to fit alignment requirements, shall not be permitted. The Engineer may order some bending or curving to allow for necessary minor adjustments.

**B. Inspection of Galvanizing.** Damage to galvanizing of steel bridge railing shall constitute sufficient cause for rejection except for the following conditions:

1. If the damaged area is not required to be repaired under the provisions of 710-23, Steel Bridge Railing.
2. If the total damaged area of a single piece (i.e. post or rail) is 6 square inches or less. Total damaged area is exclusive of the damaged area as described under §568-3.01B1.

**C. Field Galvanizing for Repair.** Field galvanizing repair shall be allowed to be performed upon damaged areas meeting the requirements of §568-3.01B2.

Field galvanizing repair shall be made by painting zinc repair material onto the damaged area in accordance with the requirements of §719-01, Galvanized Coatings and Repair Methods.

All finished surfaces of welds and adjacent surfaces of rails and posts upon which galvanizing has been removed, due to any field welding operation, shall be field galvanized.

**D. Field Welding.** Field welding shall not be permitted unless noted in the contract documents or ordered by the Engineer.

**E. Erection.** All railing shall be erected in accordance with the contract documents or, when required, the approved shop drawings prepared and submitted as specified in the New York State Steel Construction Manual.

**F. Positioning Railing.** Railing shall be erected so that the rails are parallel to each other and to the top of parapet, sidewalk or structural slab.

**G. Positioning Posts.** Posts shall be set vertical.

**H. Base Plates.** Post base plates shall be perpendicular to the post, unless otherwise noted. When the railing is to be placed on a preformed surface, the base plate may be placed parallel to the grade or may be perpendicular to the post and made level by the use of beveled shims conforming to the applicable requirements of §710-23, Steel Bridge Railing.

**I. Non-Metallic Pads.** Posts which are to be placed on a preformed surface shall be mounted on a non-metallic pad conforming to the requirements of §728-02. Beveled Shims, if required, shall be inserted between the non-metallic pad and the post base plate.

**J. Jacking Nuts.** For railings set on jacking nuts, the railing posts shall be erected to proper line and grade before concrete under the post and in back of the granite curb is placed or before the mortar pad is placed.

**K. Rail Span.** The rails of railings shall span the following minimum number of posts:

Railing Type	Number of Posts
Two-Rail, Steel	3*
Four-Rail, Steel	3
Five-Rail Steel	3

**NOTE:** \* If this is not possible, the absolute minimum shall be 2 posts if approved by the DCES.

**L. Anchor Studs.** After the anchor stud nuts have been tightened in a manner satisfactory to the Engineer, the studs shall be flame cut 1 inch above the nut. The first thread of the stud above the nut shall be damaged. The cut end of the anchor stud shall be coated in conformance with the requirements of §719-01, Galvanized coating and Repair Methods.

**M. Touch-Up Painting.** Any damage to the paint on a railing system shall be repaired in accordance with §657 Painting Galvanized Surfaces.

**N. Inspection.** All erection shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

Any single piece of the railing system with a total damaged area in excess of the amount specified in §568-3.01B2 shall be rejected and replaced.

### 568-3.02 Cement Mortar Pads

**A. Proportioning.** Cement mortar pads shall consist of a concrete grouting material.

The concrete grouting material shall meet the requirements of §701-05, Concrete Grouting Material. The grouting material shall be mixed with water, in the ratio recommended by the manufacturer, to produce a trowelable mix.

**B. Mixing.** Mixing shall be carried out in strict accordance with the manufacturers recommendations or the following as determined by the Engineer.

- All necessary mixing equipment shall be present and in good working order prior to the start of mixing.
- Mixing time shall not exceed three minutes unless otherwise permitted. No mixing shall be started until all preparations have been made to place the mortar.
- All mortar in any individual batch shall be used within 25 minutes after the start of mixing.
- Retempering will not be allowed.

**C. Surface Preparation.** All concrete surfaces to receive the mortar shall be free from laitance, oil, grease, paint, dust, loose particles or other foreign material.

The concrete surface shall be cleaned by sandblasting to the satisfaction of the Engineer, followed by a thorough vacuum cleaning.

The bottom surfaces of the base plates shall be free of oil, dirt and other foreign matter.

The concrete surface shall be lightly moistened with water.

**D. Form Preparation.** The forms shall be positioned about the base plate as shown in the plans or as directed by the Engineer. If the forms are to be coated with a release agent, it shall not be deleterious to the physical properties of the mortar system being used as determined by the Engineer.

**E. Application.** After the concrete surfaces and the base plates surfaces have been properly prepared the mortar shall be placed within the limits of the forms and tamped into place to assure that there are no voids in the completed pad. Exposed surfaces of the mortar shall be screeded and troweled to the level of the bottom of the base plate. The mortar pads shall be protected from rain for at least 24 hours.

**F. General.** In all cases, the installation of the mortar pads shall be made when the concrete and ambient air temperatures are above 50°F.

## **568-4 METHOD OF MEASUREMENT**

**568-4.01 Bridge Railing.** The quantity to be paid for bridge railing shall be the number of feet measured along the centerline of railing anchorage between the extreme outer limits indicated on the contract plans.

**568-4.02 Transition Bridge Railing.** The quantity to be paid for transition railing shall be the number of feet measured along the axis of the top rail between the limits shown on the plans.

## **568-5 BASIS OF PAYMENT**

**568-5.01 Bridge Railing.** The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. All pads (including Mortar Pads), shims, splices with their hardware, railing anchor studs with nuts, washers and anchor plates, and hand rails when specified shall also be included in the price bid.

No payment shall be made for those railing pieces which are replacements for those railing pieces that have been rejected.

Progress payments will be made when the railing is erected in accordance with the contract documents as specified in the New York State Steel Construction Manual exclusive of the cutting, peening and galvanizing of studs. Payment will be made at the unit bid price for 90% of the quantity erected. The balance of the quantity will be paid for upon proper completion of the work.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
568.50	Steel Bridge Railing (Two-Rail)	Foot
568.51	Steel Bridge Railing (Four-Rail)	Foot
568.52	Steel Bridge Railing (Five-Rail)	Foot
568.53	Steel Bridge Railing (Two-Rail) with Handrail	Foot
568.54	Steel Bridge Railing (Three-Rail)	Foot
568.60	Steel Bridge Railing - Brown (Two-Rail)	Foot
568.61	Steel Bridge Railing - Brown (Four-Rail)	Foot
568.62	Steel Bridge Railing - Brown (Five-Rail)	Foot
568.63	Steel Bridge Railing - Brown (Two-Rail) with Handrail	Foot
568.64	Steel Bridge Railing - Brown (Three-Rail)	Foot
568.70	Transition Bridge Railing	Foot
568.71	Transition Bridge Railing – Brown	Foot
568.80	Pedestrian and Bicycle Railing (One-Rail)	Foot
568.81	Pedestrian and Bicycle Railing (Two-Rail)	Foot
568.82	Pedestrian and Bicycle Railing (Three-Rail)	Foot
568.83	Pedestrian and Bicycle Railing (Four-Rail)	Foot
568.84	Pedestrian and Bicycle Railing (Five-Rail)	Foot
568.85	Pedestrian and Bicycle Railing - Brown (One-Rail)	Foot
568.86	Pedestrian and Bicycle Railing - Brown (Two-Rail)	Foot
568.87	Pedestrian and Bicycle Railing - Brown (Three-Rail)	Foot
568.88	Pedestrian and Bicycle Railing - Brown (Four-Rail)	Foot
568.89	Pedestrian and Bicycle Railing - Brown (Five-Rail)	Foot
568.90	Bicycle Railing (Two-Rail)	Foot
568.91	Bicycle Railing - Brown (Two-Rail)	Foot
568.92	Bicycle Railing (Four-Rail)	Foot
568.93	Bicycle Railing - Brown (Four-Rail)	Foot

**SECTION 569 - PERMANENT CONCRETE TRAFFIC BARRIER FOR STRUCTURES**

**569-1 DESCRIPTION**

**569-1.01 Work.** The work shall consist of constructing concrete traffic barrier, of the configuration and at the locations indicated on the Contract Plans.

**569-1.02 Methods.** Construction of the barrier shall be accomplished by cast-in-place or precast methods. Slip forming will be allowed as an acceptable cast-in-place method, unless the plans show anchor bolts projecting beyond concrete limits; in this instance slipforming procedures will require the approval of the DCES.

**569-1.03 Shape Modification.** The barrier shape indicated on the plans shall not be altered. Minor modifications, to allow slip-forming, will be submitted to the Regional Construction Engineer for approval.

**569-1.04 Approvals.** For approval requirements and procedures refer to the Construction Details.

**569-2 MATERIALS**



**569-2.01 Fabrication.** Materials used for traffic barrier fabrication shall meet the following requirements:

Precast Concrete Barrier	704-03 and 704-05
Cast-In-Place Concrete (Constructed Forms)	501, Class A Concrete
Cast-In-Place Concrete (Slip Formed)	501, Class J
Epoxy Coated Reinforcing Bars	709-04
Steel Tubes	ASTM A500, Grade B
Steel Plates, or Bars	ASTM A36 or A588 (A709 Grade 36 or 50W)
Anchor Bolts (Fully Threaded)	ASTM F3125 GRADE A325 or A449 Type 1
Nuts	ASTM A563, Class 10S HH
Washers	ASTM F436, Type 1 or 3
Concrete Grouting Material	701-05
Concrete Repair Material	701-04
Concrete Repair Material - High Early Strength	701-12
Joint Filler	ASTM D1056, Grade 2B1 or 2B2.
Curing Compound	711-05
Locking and anchoring devices for precast units	715-01 and 709-04, as applicable
Galvanizing	719-01

All steel, except reinforcing steel, shall be galvanized.

**569-2.02 Fabrication Tolerances.** All cast-in-place concrete barrier, regardless of the method of construction, shall conform to the following finished tolerances:

Bar Reinforcement Cover	-0 , + 1/2 inch
Width (Top)	-0 , + 1/4 inch
Width (Bottom)	-0 , + 1/2 inch
Surface Straightness (Deviation from theoretical centerline)	1/2 inch in 20 feet
Vertical Alignment (Deviation from a line parallel to the theoretical grade line)	1/2 inch in 20 feet
Horizontal and Vertical Misalignment (between adjacent precast units)	3/16 inch

All precast concrete barrier shall conform to the tolerances contained in §704-03, §704-05 and to the foregoing misalignment tolerance.

Reinforcement cover shall be verified while the concrete is still plastic, except in the case of cured precast units. In that case, cover will be verified in accordance with established Department procedures.

These procedures may include coring.

### 569-3 CONSTRUCTION DETAILS

#### 569-3.01 Approvals

**A. Cast-In-Place Concrete - Modifications to Contract Plans.** The DCES shall be supplied with three copies of pertinent details and necessary design computations. Every effort will be made to render a decision, in a timely manner, after all pertinent information has been received. However, the time required to render a determination will not be taken into account should the Contractor request an extension of time.

**B. Precast Concrete.** Precast barrier systems shall be approved by the DCES prior to the contract award in order to be used in the contract.

### **569-3.02 General: Cast In Place Concrete**

**A. Cleaning.** Surfaces against which barrier is to be placed shall be thoroughly cleaned and vacuumed to remove any dirt or other foreign substances, laitance or partially loose chips of concrete.

**B. Defects.** Defects are divided into two categories: minor defects and major defects. Minor defects in the barrier shall be repaired. Major defects shall be cause for rejection of the section. Such rejected sections shall be removed and replaced or, upon approval of the Engineer, the section shall be repaired to the satisfaction of the Engineer.

**1. Minor Defects.** Minor defects are defined as holes, honeycombing or spalls which are 6 inches or less, in diameter, and which do not expose the outermost surface of the steel reinforcement. Surface voids 5/8 inch, or less, in diameter, and 1/4 inch, or less in depth are not considered defects. They do not require repair.

**2. Major Defects.** Major defects are defined as:

- a. Any defect, except as noted in §569-3.02 B.1. above which does not meet the definition of a minor defect.
- b. Minor defects which, in aggregate, comprise more than five percent (5%) of the surface of the barrier section.

**C. Repair.** Repair shall be made with a material acceptable under §701-04 or §701-12. Methods of repair shall be acceptable to the Engineer. The color of the repaired portion shall match, as nearly as practicable, the color of the surrounding concrete. Repaired portions shall exactly match shape requirements. The repaired portion shall withstand a moderate blow from a 16 ounce hammer. Repair shall be done at no cost to the State.

**569-3.03 General: Precast Concrete.** The definition of defects and the repair requirements contained in 704-03 shall apply.

**569-3.04 Cast-In-Place Concrete - Constructed Forms.** The requirements of Section 555 and Section 556 shall apply with the following modification:

Thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the surfaces from drying, so the concrete remains in a saturated surface dry condition until placement of the new concrete. If the forms are removed before seven curing days have passed, the concrete shall be cured by means of a clear curing compound. No curing blankets will be required.

Curing compound shall be sprayed on the concrete surface immediately following the slipforming and hand finishing operations. The compound shall be applied by means of pressure spraying or distributing equipment at the rate directed by the Engineer, but not less than 1 gallon per 150 square feet of surface. The equipment for applying the compound shall be such that the compound is applied as a fine spray with no surface damage to the concrete. The equipment shall also provide adequate agitation of the compound during application, and shall be approved by the Engineer before work is started. Should the method of applying the compound produce a non-uniform film, or should the spraying equipment fail and duplicate equipment not be immediately available, the application of curing compound shall be discontinued immediately and the curing shall be accomplished by another method acceptable to the Engineer. The

Contractor shall stockpile sufficient approved coverings for protection of the concrete in the event of rain, non-uniform film application, or breakdown of spray equipment.

**569-3.05 Cast-In-Place Concrete - Slipformed.** The requirements of Section 555, Section 556 and the following, shall apply:

**A.** The forming of the barrier shall be accomplished by self-propelled equipment approved by the Engineer. The requirements of 555-3.03 shall not apply. Thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the surfaces from drying, so the concrete remains in a saturated surface dry condition until placement of the new concrete.

**B.** After all reinforcing bars have been placed, all bridge joints installed, and all other hardware placed in the area of the barrier, the Contractor shall perform a "dry run" over the entire length of the barrier installation location. It is necessary only to "dry run" a single day's placement during any given day; however, the entire barrier length shall be traversed.

The "dry run" may be made with either the actual slip forming equipment, or with an exact "mock-up" of the equipment. The "mock-up"; if utilized, shall be the exact size, shape and dimensions of the slip forming equipment. It shall be a minimum of 4 feet long. Its movement shall be able to be correlated with a string, or survey, line indicating the correct offset location of the barrier.

**C.** After the "dry run" portion of the work has been completed and all obstructions have been cleared, the slip-forming equipment shall be demonstrated for capability. The demonstration shall be done in the presence of the Engineer. The Contractor shall make all adjustments, or alterations, to ensure that the equipment has the capability to produce an acceptable product. No work shall be done without the Engineer's approval. The capability demonstration will be required only once for each piece of forming equipment used on the project.

**D.** The Engineer's approval is for equipment capability only. The Contractor shall be entirely responsible for meeting the tolerances given under MATERIALS, 569-2.03. Fabrication Tolerances. Sections which do not meet tolerance requirements are subject to removal and replacement at no cost to the State, at the discretion of the Engineer.

**E. Central and Transit Mixed Concrete.** The provisions of 501-3.03 C and D shall apply for Central Mixed and Transit Mixed Concrete respectively, except that water may be added to the mixture one additional time at the point of deposition to maintain the desired slump. The water addition may be made anytime after the beginning of discharge until approximately two-thirds of the load, as determined by the Engineer, has been discharged. After the water addition, the concrete shall be mixed at least 30 revolutions in the mixing range. When the water addition is made after discharge the total number of revolutions shall not be more than 190.

Truck Mixed Concrete. The provisions of §501-3.03 E shall apply except that after initial slump has been achieved, water may be added to the mixture one additional time to maintain the desired slump. The water addition may be made anytime after the beginning of discharge until approximately two-thirds of the load, as determined by the Engineer, has been discharged. After the water addition, the concrete shall be mixed at least 30 revolutions in the mixing range.

**F.** Concrete supply shall be sufficient to produce a continuous, completely shaped barrier. If concrete placement is interrupted, for any reason, the placement shall be protected from drying by several layers of wet burlap. A construction dam, or bulkhead, shall be installed if the interruption exceeds

30 minutes. If the interruption exceeds 90 minutes, further placement shall be discontinued. Concrete placement at this location may then resume only after 12 hours, measured from the time of delay, has elapsed.

**G.** Concrete placement may begin at the joint beyond the bulkhead without time constraints. If the length of placement between the bulkhead and the next joint is such that, in the opinion of the Engineer, it may not be slipformed, the Contractor shall form the section by methods other than slipforming.

**H.** Cold joints in the barrier, that is, joints formed due to the attachment of fresh concrete to set concrete, shall be made in the following manner. The set concrete shall have its surface cut to remove all loose, and otherwise unsatisfactory materials. Tools used for this purpose shall be approved by the Engineer, prior to use. The surface shall be scrubbed with wire brooms and shall be kept wet until new concrete is placed.

**I.** The Contractor shall make provisions to allow hand finishing, should it be necessary, on all surfaces. Hand finishing, if done, shall be done immediately after the passage of the slipforming equipment. Curing compound shall be applied only after hand finishing has been completed at any particular location.

**J.** Concrete shall be cured by means of a clear curing compound in accordance with the requirements of 569-3.04.

**K.** Joints and construction grooves shall be introduced at the locations indicated on the Contract Plans. If sawcutting methods are employed the following requirements shall apply:

1. The equipment shall be demonstrated, for capability, to the Engineer.
2. No sawcuts, for any purpose, shall be made in the structural slab.
3. In order to avoid sawcuts in the structural slab, the portion of the joint 3 inches directly above the structural slab shall be hand tooled immediately after finishing.
4. All sawcuts shall be made normal to the structural slab surface. The joints shall be sawcut as soon as no damage to the concrete will result with a maximum time of 8 hours. The clear curing compound shall be reapplied at the sawcut.

### **569-3.06 Precast Concrete**

**A.** Immediately prior to installation, the barrier units shall be inspected for defects. Defects which conform to the definition of minor defects as given in §704-03 shall be repaired in accordance with the requirements of that subsection.

After the inspection for defects has been completed, the contact surface of all precast barrier shall be sandblast cleaned in accordance with the requirements of §584-3.02A, and §584-3.02C. After sandblasting operations are completed the surfaces shall be thoroughly vacuum cleaned.

**B.** After the cleaned surface has been accepted, thoroughly wet the surface over which the precast barrier will be placed for at least 12 hours immediately prior to placing the grout bed. Remove all standing water with oil-free compressed air, and protect the surface from drying, so the surface remains in a saturated surface dry condition when placing the grout bed. All precast barrier shall be installed on grout beds conforming to the requirements of §701-05 as modified herein. The exact bedding placement requirements shall be established by the barrier system manufacturer. However, no grout bed shall be greater than 1/2 inch in thickness after the barrier has been installed in its permanent position. All grout bedding material shall be tooled flush with the barrier edge.

Care shall be taken to prevent grout from setting prior to barrier unit installation. If, in the opinion of the Engineer, the grout has set, or has begun to set, it shall be removed. No retempering will be permitted. The affected installation area shall be thoroughly cleaned of grout, by methods acceptable to the Engineer, and new grout shall be placed, all at no additional cost. All vertical adjustments shall be made by the addition, or removal, of grout. No wedges will be permitted.

Lifting of the barrier which, in the Engineer's opinion, will result in permanent voids occurring between the barrier unit and the grout bed, will not be permitted.

**C.** Unless otherwise noted joints between units shall utilize materials required by ASTM D1056, Grade 2B1 or 2B2 and shall be installed in the manner indicated on the approved precast barrier system drawings.

**D.** Units which are damaged during installation, due to the Contractor's operations, shall be repaired, or replaced, as determined by the Engineer. Repair or replacement shall be done at no cost to the State.

**E.** Precast barrier anchored to the underlying support by means of drilled-in-bolts, may be anchored by one of two methods:

**1. Bolts chemically anchored to the underlying support.** Holes drilled for this method will not go completely through the underlying support. Bolt installations will be subjected to load testing acceptance requirements.

**2. Bolts mechanically anchored to the bottom of the underlying support.** Holes drilled for this method will go completely through the underlying support. Bolt installations will not be load tested.

**569-3.07 Requirements for Method permitted under §569-3.06E1**

A. Drilling shall be done by means of a rotary impact drill. Hole diameter shall be in strict accordance with the grout manufacturer's instructions. If reinforcing steel is encountered, the reinforcing shall be cut and removed by means of a core drill. If approved by the Engineer, hole locations may be moved to avoid encountering reinforcing steel. The remainder of the drilling shall be done by rotary impact drill.

Drilling with a lubricant will not be permitted. Water use is permissible. Concrete spalled, or otherwise damaged by the contractor's operations shall be repaired, in a manner approved by and, to the satisfaction of the Engineer, at no additional cost.

B. Unless otherwise specified in the Contract Documents, the minimum depth of embedment of the anchor bolt shall be in accordance with Table 569-1.

The Contractor may increase the embedment length beyond that shown on the Plans or specified in the above table provided 1) the increase is done at no additional cost to the State and 2) the hole stops at least 2 inches from the bottom of the structural slab.

<b>TABLE 569-1 MINIMUM EMBEDMENT AND REQUIRED TEST LOAD</b>								
<b>Nominal Anchor Bolt Diameter (inches)</b>	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4
<b>Embedment Length (inches)</b>	5 1/2	6	6 1/2	8	8 1/2	10	12	15
<b>Test Load (kips)</b>	11	14	17	25	35	45	50	65

C. Grouting material shall be a non-metallic, non-shrink grout, or polymer resin. It shall contain no products which promote the corrosion of steel. When cured, the material shall exhibit a maximum loss of four percent (4%) when tested for freeze-thaw resistance. Freeze-thaw testing will be done in accordance

with Materials Test Method 502-3P, except that the material will be subjected to 50 cycles of testing. Cured material shall not be reactive with salt water, portland cement, or petroleum products.

The contractor shall supply the Engineer with two copies of the grout manufacturer's certification that the material meets the foregoing requirements.

D. All anchor bolts shall be inserted at least the specified depth into the hole. After insertion of the bolt, all excess grout shall be struck-off flush with the concrete face. Should the grout fail to fill the hole, additional grout shall be added to the hole to allow a flush strike-off.

E. A portion of each lot of grouted-in anchor bolts shall be designated by the Engineer for load testing. The first lot shall consist of the first 10 grouted in anchor bolts. The remaining lots shall be defined by the Contractor subject to the following:

- The lot size shall not exceed 600 anchor bolts.
- A lot shall only include anchor bolts installed during a single construction season.
- A lot shall only include anchor bolts grouted with the same grout or resin.

Unless otherwise specified in the Contract Documents, the minimum load applied during the load testing shall be in accordance with Table 569-1.

Table 569-2 shows the lot size (column L), the initial number of anchor bolts selected for testing (column N1) and the number of anchor bolts selected for additional testing (column N2).

<b>TABLE 569-2 SAMPLING PLAN FOR ANCHOR BOLT PROOF LOAD TESTING</b>		
<b>Lot Size L</b>	<b>Initial Sample Size N1</b>	<b>Additional Test Sample Size N2</b>
1-30	All the bolts in the lot	---
31-50	30	---
51-75	38	---
76-100	44	21
101-200	49	26
201-300	50	30
301-600	55	30

**NOTES:**

1. If all of the N1 anchor bolts selected for testing pass the load test, then the lot shall be accepted.
2. If the lot size is 75 or less and one or more of the N1 anchor bolts fail the load test, then all the anchor bolts in the lot shall be tested.
3. If the lot size is 76 or greater and only 1 of the N1 anchor bolts fails the load test, the Engineer shall designate an additional N2 anchor bolts for testing. If none of the N2 anchor bolts fail the load test, the lot shall be accepted. If any of the N2 anchor bolts fails the load tests all of the anchor bolts in the lot shall be tested.
4. If the lot size is 76 or greater, and more than one of the N1 anchor bolts fail the load testing then all the anchor bolts in the lot shall be tested.

Anchor bolts shall be deemed to pass if the specified test load is attained without permanently displacing the anchor bolts. **THIS LOAD TESTING SHOULD BE NON-DESTRUCTIVE. LOADING SHOULD BE STOPPED AS SOON AS THE MINIMUM ACCEPTABLE PULL-OUT RESISTANCE IS ATTAINED.**

F. The testing equipment shall consist of a calibrated jack system, a frame to distribute the jack load, couplers to connect the jack to the anchor bolts, and safety devices. Prior to starting the testing, the Contractor shall supply the Engineer with a certificate of calibration for the jack less than 6 months old.

Supports for the frame used to distribute the jack load shall be located outside a circle centered at the anchor bolt and of a diameter equal to 2 inches plus twice the anchor bolt embedment length but need not exceed 2 feet. The frame and jack shall be positioned so that the load is applied along the centerline of

the anchor bolt. Chains or cables shall be used to connect the various pieces of the tensioning system so that free projectiles will not be created by a failure of an anchor bolt anchorage, coupling or other portion of the tensioning system.

G. All anchor bolts which fail load testing shall be replaced and load tested in accordance with the foregoing requirements at no additional cost.

**569-3.08 Requirements for Method permitted under §569-3.06E2**

A. The requirements of §569-3.07A shall apply.

B. Grouting material shall meet the requirements of §701-05. It shall be mixed and placed in strict accordance with the grout manufacturer's instructions unless otherwise modified by the contract documents.

C. Both hole and bolt shall be clean and dry at the time of bolt insertion. The bolt shall be held in place such that it will remain vertical during subsequent grout placement. The method of bolt retention shall be such that the grout will be held within the hole until setting is complete.

Barrier units mechanically anchored to the underlying support by means of bolting shall be grouted into place in accordance with the following:

- Grout shall be prepared in accordance with the grout manufacturer's written instructions. Two copies of the manufacturer's instructions shall be delivered to the Engineer a minimum of two weeks prior to the beginning of barrier installation work.
- Grout shall be placed only if the ambient air temperature is at least 50°F and is predicted to rise. No grout shall be placed if the ambient air temperature falls below 45°F, unless external heat has been provided in the manner required by §555-3.08. The underlying support may be used as the floor of the enclosure if the Engineer approves.
- External heat shall be maintained for a minimum of seven curing days. A curing day is defined by §555-3.08A. After seven curing days have passed, or the grout has reached a minimum compressive strength of 3000 psi, whichever occurs last, the enclosure may be removed. All work of providing external heat shall be done at no additional cost.

**569-4 METHOD OF MEASUREMENT.** The work will be measured as the number of feet of concrete traffic barrier installed. Measurement will be taken along the centerline of the top of the barrier. No deduction will be made for joints.

**569-5 BASIS OF PAYMENT**

A. The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work. This price shall also include the cost of bar reinforcement, drilling, and testing.

B. In the case of barrier constructed by cast-in-place methods, 40% of the quantity will be paid for after all of the bar reinforcement has been placed and approved by the Engineer. This payment shall include the cost of chairs, supports, fastenings, connections and any splices not specifically indicated on the plans. If the Engineer permits the substitution of larger bars than those specified, or the DCES permits splices not indicated on the plans, the payment will not be increased nor will any extra compensation be considered.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
569.01	Permanent Concrete Traffic Barrier for Structures (Full Section)	Foot
569.02	Permanent Concrete Traffic Barrier for Structures (Half Section)	Foot
569.03	Vertical Faced Concrete Parapet	Foot
569.04	Single Slope (Half-Section) Concrete Bridge Barrier	Foot
569.05	Single Slope (Full-Section) Concrete Bridge Barrier	Foot

569.06	F-Shaped (Half-Section) Concrete Bridge Barrier	Foot
569.07	F-Shaped (Full-Section) Concrete Bridge Barrier	Foot
569.08	Texas Aesthetic Concrete Bridge Barrier	Foot

## SECTION 570 - PAINT REMOVAL OPERATIONS

**570-1 DESCRIPTION.** This work shall consist of providing environmental protection and developing and implementing a worker Lead Health Safety program during paint removal operations.

Whenever a structure spans over a railroad, covers shall be placed and maintained in accordance with §105-09 Work Affecting Railroads. Structures that span a navigable waterway may be subject to regulation by various agencies.

**570-1.01 Lead-Exposure Control Plan (LECP).** This work shall consist of the development and implementation of a Lead Exposure Control Plan to protect workers from the harmful effects of lead exposure in accordance with 29 CFR Subpart D. Work activities which may expose workers to health hazards include, but are not limited to abrasive blasting, paint removal, torch-cutting, welding, grinding, and rivet busting.

**570-1.02 Medical Testing.** This work shall consist of medical testing to monitor the safety of workers with lead exposures.

**570-1.03 Personal-Exposure-Monitoring Sample Analysis.** This work shall consist of monitoring the exposure levels of workers to define the hazard and/or to verify the effectiveness of control measures.

**570-1.04 Decontamination Facilities.** This work shall consist of installation, operation, maintenance, and cleaning of decontamination facilities for personnel with lead exposures.

**570-1.05 Environmental Ground Protection.** This work shall consist of the collection and removal of waste materials, including old paint chips, corrosion residues, spent abrasives, and newly applied paint that result from cleaning and painting operations as specified in the contract documents or as directed by the Engineer.

**570-1.06 Environmental Water Protection.** This work shall consist of the collection and removal of waste materials, including paint chips, corrosion residues, spent abrasives and newly applied paint that result from cleaning and painting operations as specified in the contract documents or as directed by the Engineer.

**570-1.07 Class B Containment.** This work shall consist of furnishing, installing, and removing a containment enclosure around the work area used to contain and collect debris generated during paint removal and surface preparation using vacuum shrouded power tools, vacuum blasters, and hand tools. Open abrasive blasting shall not be conducted in a Class B containment.

**570-1.08 Class A Containment.** This work shall consist of furnishing, installing, and removing a total containment enclosure around the immediate work area to contain and collect debris generated during paint removal and surface preparation operations as specified in the contract documents or as directed by the Engineer.

**570-2 MATERIALS.** A high-efficiency particulate air (HEPA) filter shall be defined as a filter that is at least 99.97% efficient against particles that are 0.3µm in diameter.



## 570-3 CONSTRUCTION DETAILS

**570-3.01 Lead-Exposure Control Plan (LECP).** At least 20 calendar days prior to starting any work which could entail employee exposure to lead, the Contractor shall submit two copies of a written Lead-Exposure Control Plan (LECP) to the Engineer for review and acceptance. This LECP shall address all of the elements required by 29 CFR Subpart D and shall be coordinated with, and need not be repeated in, the site-specific Health and Safety Plan. The Contractor shall not begin any work which could entail lead exposure until the LECP has been accepted by the Engineer.

Submission of the LECP and its acceptance by the Engineer shall not be construed to imply approval of any particular method for addressing lead health and safety concerns, or to relieve the Contractor of the responsibility for adequately protecting the health and safety of all workers.

A competent person shall have current training as SSPC C-3, Competent Person Training for Deleading of Industrial Structures, or the SSPC C-5 refresher training class.

**A. Industrial Hygienist.** Where required, the Contractor shall engage an Industrial Hygienist (IH) meeting one or more of the following qualifications:

- Current certification by the American Board of Industrial Hygiene.
- A Bachelor's Degree in engineering, chemistry, physics, biological sciences, industrial hygiene, toxicology, the environmental sciences or a related field, and at least three years of documented full-time work as an IH, including field and sampling experience.
- A Master's Degree in one of the above fields, and at least two years of documented full-time work as an IH, including field and sampling experience.

The IH shall have the following responsibilities:

- Development of a written LECP, LECP updates, and preparation of monthly summary reports.
- Provide general oversight of all aspects of the LECP.
- Review all employee medical tests and exposure monitoring results. If required, take corrective actions.
- Intervention by the IH, consisting of an on-site investigation by the IH, implementation of corrective action, and notification of the Engineer in the next monthly report if either of the following conditions are encountered:
  - Blood Lead Level (BLL) > 40 µg/dL (micrograms/deciliter) for one or more workers.
  - BLL increase of 10 µg/dL or more between successive tests for any individual worker.
  - Inspect the work site at least monthly during work which produces a potential lead exposure, except where the Contractor documents that employee lead exposure will be below the Permissible Exposure Limit (PEL).

**B. Exposure Below the Action Level.** If the Contractor can document by air monitoring or the use of appropriate historical data that lead exposure for all employees will be below the Action Level ( $\square$ g/m<sup>3</sup>), then the Contractor shall develop a written LECP including, but not limited to the following:

- A description of the Contractor's lead health and safety organization, including the responsibilities and qualifications of the competent person, and the project Health and Safety Officer.
- A description of OSHA required lead training provided to both supervisors and workers.
- A description of each activity which will entail a risk for lead exposure.
- An initial assessment of anticipated exposure level(s), including any relevant historical exposure monitoring data.

- A description of arrangements for ensuring that Subcontractors will comply with the LECP.
- Plans for updating the LECP.
- Plans for keeping and maintaining records.
- Exposure monitoring.

**C. *Exposure Above the Action Level and Below the Permissible Exposure Limit.*** If the Contractor can document by air monitoring or the use of appropriate historical data that the highest employee lead exposure will be above the Action Level ( $30 \mu\text{g}/\text{m}^3$ ), but below the Permissible Exposure Limit ( $50 \mu\text{g}/\text{m}^3$ ), then the Contractor shall develop a written LECP under the direction of an IH, with day-to-day supervision by the competent person, including, but not limited to, the items listed under paragraph B above and the following:

- Medical surveillance and removal program.
- Notifying employees and the Engineer of the results of exposure monitoring and medical tests.
- Worker and supervisor training.
- Monthly summary reports.
- Plans for worker and supervisor lead training.
- Plans for performing exposure monitoring and for notifying employees and the Engineer of results.
- A description of the Contractor's medical surveillance and removal program, including plans for notifying employees and the Engineer of results. This description shall include the names and addresses of the clinic(s) where testing will be performed and of the OSHA-approved laboratory where blood samples will be analyzed.

**D. *Exposure At or Above the Permissible Exposure Limit.*** When the highest employee lead exposure will be above the Permissible Exposure Limit ( $50 \mu\text{g}/\text{m}^3$ ), the Contractor shall develop a written LECP under the direction of an IH, with day-to-day supervision by the competent person. The LECP shall include, but not be limited to, the items listed under paragraphs B and C above and the following:

- A description of the engineering, administrative, and work practice controls which will be used to reduce exposure. All feasible engineering, administrative, and work practice controls shall be implemented before considering the use of respirators to reduce exposure.
- Decontamination facilities to be provided including a description and floor plan, a description of any hand-wash stations to be provided, and a description of mandatory hygiene practices which employees will be required to follow.
- A description of a Respirator Program including respirator-fit testing and respirator training.
- A description of Provision of Personal Protective Equipment (PPE), including required cleaning and/or replacement.
- Plans for posting and maintenance of warning signs in high-exposure areas.
- Schedule of periodic work site inspections by the IH and the competent person.

**E. *Monthly Summary Reports.*** Except where the Contractor can document that employee lead exposure will be below the Action Level, for each month of work which entails potential lead exposure, the Contractor shall submit a monthly summary report to the Engineer which has been reviewed and signed by the IH not later than the 15<sup>th</sup> of the following month. This report shall contain the following elements:

1. A summary of the work producing potential lead exposure completed in the past month.

2. A description of any interventions or deficiencies noted, and a summary of corrective actions.
3. A summary of exposure monitoring or medical testing results which were completed in the past month. To protect worker privacy, these results shall not include individual names; instead, workers shall be identified by trade and with an individual control number (not Social Security Number) to allow tracking of their exposure.
4. A certification that, with the exception of any deficiencies noted, the past month's work has been in compliance with the requirements of 29 CFR 1926.62 and this specification.

**570-3.02 Medical Testing.** The Contractor shall arrange for employees to receive all required medical tests. All medical tests shall be completed by, or under the supervision of, a licensed physician. Blood sampling and analysis shall meet the accuracy requirements of 29 CFR Subpart D and shall be conducted by an OSHA-approved laboratory. The Contractor shall provide the Engineer a summary of medical testing results which were completed in the past month prior to a request for payment. The Contractor shall provide documentation of any medical removals, a description of what triggered them, and the corrective measures taken. The Contractor shall provide an exit medical exam consisting of blood sampling and analysis for lead and zinc protoporphyrin (ZPP) levels for all workers who were potentially exposed within 5 work days of the time a worker completes or is removed from all work which entails a potential for lead exposure. Exit exams shall also be offered within 5 work days of seasonal shutdown or for other periods exceeding 30 calendar days in which no work involving potential lead exposure is scheduled or anticipated. The results of all medical tests shall be provided to affected workers within 5 work days of receipt, and to the Engineer in the next monthly report.

For employees who are offered an exam but choose not to participate or fail to respond, the Contractor shall provide a written declination signed by the worker or, for workers who are no longer on the payroll, a registered letter to the worker's last known address.

**570-3.03 Personal-Exposure-Monitoring Sample Analysis.** The Contractor shall conduct exposure monitoring. Exposure monitoring samples shall be obtained by the IH, a competent person under the direction of the IH, or other qualified persons as specified in the LECP. Exposure monitoring samples shall be analyzed by a laboratory selected by the Contractor, using a method which meets the accuracy requirements of 29 CFR Subpart D. The Contractor shall provide the Engineer a summary of exposure monitoring sample test results which were completed in the past month prior to a request for payment.

**570-3.04 Decontamination Facilities.** Except where the Contractor can document that employee lead exposure will be below the PEL, a minimum of one climate-controlled decontamination facility shall be provided, and shall be utilized by all workers with potential lead exposure. The number of facilities to be provided will be dictated by site conditions and by the Contractor's sequence of operations and shall be approved by the IH and the Engineer.

Each facility shall consist of a "clean" area where workers can remove and store their street clothing when they arrive on site; a shower room with hot and cold running water, soap and clean towels; and a "dirty" area where workers can remove and store their work clothing and PPE at the end of their work shift. The "clean" area and the "dirty" area shall each have a separate entrance. Decontamination facilities shall be cleaned as required, or at least once every week of use. All waste water generated from showers or as a result of cleaning operations shall either be tested and filtered through a 5 µm filter or considered as lead contaminated, and disposed of in accordance with State and Federal regulations.

#### **570-3.05 Environmental Ground Protection.**

**A. General.** Covers shall be provided on or over the ground under all structures that are to be cleaned and painted. Depositing or dropping waste materials into water and onto the ground or roadways outside the specified collection areas is not permitted.

The length of the cover shall be 10 feet longer on each end than the length of the work area, and the width shall be at least 10 feet wider on each side of the work area. The cover shall be positioned in such a manner as to contain and prevent the loss of waste materials.

Environmental Ground Protection shall consist of covers or other material capable of catching and holding waste materials on or over the ground under the structure in the work area. A bridge deck or a highway pavement and paved shoulder under a structure from which wastes may be collected and removed by vacuuming may be used in place of a cover providing that within that area such usage is confined to lanes and shoulders closed to traffic.

Covers on or over roadways or railroads or sidewalks or other similar areas shall not present a hazard of any kind and no cover shall remain in place overnight unless otherwise authorized by the Engineer.

**B. Containment Operations.** Cleaning or painting operations shall not be performed when the direction or velocity of prevailing winds causes waste materials to fall outside the collection area. If wind or other factors prevent collection, the Contractor may, with the approval of the Engineer, use drapes or other means to prevent drift beyond all specified collection areas.

**C. Waste Collection.** All waste materials shall be removed from the ground protection by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials from the ground protection is not permitted. Air exhausted from vacuuming equipment shall pass through a HEPA filtering system.

All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more frequently if directed by the Engineer. No waste material shall remain on the bridge deck, pavement, pier, pedestals, abutments, or containment covers overnight.

### **570-3.06 Environmental Waterway Protection.**

**A. General.** Covers shall be provided under all structures that span bodies of water, waterways, and stream beds, and that are to be cleaned and painted in the field. Depositing or dropping waste materials into water and onto the ground or roadways outside the specified collection areas is not permitted.

A cover shall be suspended from the structure and shall, as measured over the water, be at least 10 feet greater in length and at least 10 feet wider than each side of the area on which work is underway. The cover shall be positioned in a manner so as to collect and prevent the loss of waste materials. The cover shall not remain in place overnight if it presents a hazard of any kind.

If floating waste materials form on the water surface, they shall be contained from moving upstream or downstream. Floating waste material shall be collected daily, or more frequently. Straw or screening used in the fabrication of water booms shall be replaced with clean material weekly or as otherwise directed by the Engineer.

**B. Containment Operations.** Cleaning or painting operations shall not be performed when the direction or velocity of prevailing winds causes waste materials to fall outside the collection area. If wind or other factors prevent collection the Contractor may, with the approval of the Engineer, use drapes or other means to prevent drift beyond all specified collection areas.

**C. Waste Collection.** All waste materials shall be removed from the waterway protection by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials from the waterway protection is not permitted. Air exhausted from vacuuming equipment shall pass through a HEPA filtering system.

All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more frequently if directed by the Engineer. No waste material shall remain on the bridge deck, pavement, pier, pedestals, abutments, or containment covers overnight.

### **570-3.07 Class B Containment.**

**A. General.** The containment system includes the cover panels, screens, tarps, scaffolds, supports, and shrouds used to enclose an entire work area. The purpose of the containment is to prevent debris generated during surface preparation from entering the environment and to facilitate the controlled collection of the debris for disposal.

The containment shall meet the requirements of SSPC-Guide 6, Class 2P. The containment may have either air penetrable or impenetrable walls, rigid or flexible framing, shall have fully sealed joints, and shall have overlapping entry ways. Flexible covers for flooring shall be impermeable and will be allowed only if the ground or paved surfaces are smooth enough to vacuum debris. If a smooth surface is not available, rigid materials shall be used for the floor of the enclosure.

**B. Containment Operations.** All cleaning and paint removal work and all work associated with the collection of paint waste debris, including the subsequent air blow-down or vacuuming of debris from the steel surfaces on the structure in preparation for painting, shall be performed inside the containment enclosure.

The Contractor shall make every attempt to limit workers from entering or exiting the containment enclosure when paint removal operations are being performed.

**C. Waste Collection.** Following paint removal work, all steel surfaces inside containment shall be vacuumed of debris. All waste material that results from paint removal operations shall be cleaned up and collected from the floor, walls, and other surfaces inside of the containment enclosure by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials will not be allowed. Cleanup operations shall be performed daily, prior to inspection, before new paint is applied or before a prolonged work stoppage, such as for weather interruptions.

Prior to disassembly or moving of the containment enclosure, the inside surfaces of the enclosure shall be cleaned of dust and other spent material by vacuuming. The Contractor shall take all measures necessary to prevent the release of waste material during moving or removal of the containment.

All vacuum equipment that is used for collection and clean up work shall be equipped with HEPA filters. All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable local, State, and Federal Laws, regulations, and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

**D. Ventilation.** Ventilation inside the enclosure is not specifically required and may be by natural means. It may be necessary to provide mechanical ventilation to meet OSHA requirements for worker exposure to lead and other provisions. If mechanical ventilation is provided to address these requirements, filtration of exit air is not required.

**E. Lighting.** Light intensity by natural or artificial means inside the containment enclosure shall be maintained at a minimum of 50 foot-candles on the steel surface. During inspection activities, light shall be maintained at a minimum of 100 foot-candles. Auxiliary lighting shall be provided as necessary. The Contractor shall provide the Engineer with one portable light meter with a scale of 0 to 100 foot-candles. This meter will be returned to the Contractor at the completion of work. All lighting used in the containment shall be explosion-proof.

**F. Containment Performance.** The effectiveness of the containment enclosure shall be determined by visual inspection for dust plumes or other visible evidence of emissions materials into the environment. Throughout the duration of work there shall be no visible discharges. If there is a visible discharge the Contractor shall immediately stop work and perform necessary repairs to the containment enclosure or modifications to cleaning operations to the Engineer's satisfaction.

The Engineer may direct the Contractor to stop all work activities and immediately clean up all waste materials within the enclosure when threatening weather conditions exist or are predicted. This measure may be exercised when an apparent threat exists that could cause the release of waste material to the surrounding environment, such as high winds or heavy rain.

If the wind velocity causes the containment enclosure to billow, or to emit dust, or to otherwise be a hazard in the opinion of the Engineer, the Contractor shall immediately cease work and clean up all the debris. Under severe conditions the Contractor shall disassemble the containment enclosure.

**G. Releases From the Containment.** For structures that are located over or adjacent to water, if floating waste materials form on the water surface, they shall be contained from moving upstream or downstream by the use of floating water booms. Floating waste material shall be collected daily, or more frequently.

Any waste material that is released outside the containment enclosure shall be immediately cleaned up using vacuums. Care shall be taken on pavement and other surfaces to collect all waste material so as to prevent it from being redistributed into the air and environment by traffic or other means.

All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable Local, State, and Federal Laws, regulations and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

**570-3.08 Class A Containment.** Fifteen (15) days prior to the start of any abrasive-blast cleaning or paint removal work, the Contractor shall submit for approval detailed working drawing(s) of the Class A containment system that is to be supplied for each structure. The drawings shall be prepared and stamped by a Professional Engineer. Six (6) complete copies of the working drawings shall be submitted for approval.

The working drawings shall detail the proposed containment enclosure and include the following information at a minimum:

- Plan and elevation of the containment enclosure in relation to the structure.
- The type of solid or rigid floor and working platform with appropriate safety and fall protection measures. A description of worker access to the enclosure and the procedures and equipment that will be used to provide fall-protection. If a barge or another type of floating platform is used, include details regarding its construction, such as materials and dimensions, how the platform will be tied-off, how the debris will be collected and off- loaded, etc.
- A description of how the existing drainage will be routed through the enclosure.
- A description of the type of material(s) for the containment walls, floor, and ceiling.
- The type of support structure that will be used for the floor, walls, and ceiling, including the attachment of the enclosure materials to the support structure.
- The method by which the enclosure will be supported or attached to the bridge, i.e., rollers, clamps. Welding, bolting, or similar connections will not be allowed.
- The method that will be used to seal the joints (seams) formed when fabricating the containment enclosure, and the method that will be used to seal the mating joints between the containment enclosure and the bridge structure.

- The method that will be used to seal the entryway. At a minimum, the use of multiple overlapping door tarps shall be provided to minimize dust escape through the entryway.
- The ventilation system including open-air make-up points, dust collector and exhaust fan(s), location, type of equipment, manufacturer's data sheets, and airflow capacities.
- The type, size, and configuration of auxiliary lighting provided inside the containment enclosure. All lighting must be explosion proof.
- A design analysis of the loads on the structure due to the containment enclosure including: maximum dead and live loads of the enclosure, the workers, blast abrasive, and equipment; maximum allowable load for the floor and working platform; wind loads imposed on the structure by the enclosure; and maximum wind velocity that the containment enclosure is designed to withstand.
- If the containment system is supported by the structure, the working drawing submittal shall include certification by the Professional Engineer that the loads imposed do not cause the overall stress level of any element of the bridge to exceed the Operating Rating Allowable Stresses defined in AASHTO Manual for Maintenance Inspection of Bridges.
- The analysis shall account for all loads on the structure, including the enclosure dead load, worker live load, blast-abrasive load, equipment load, wind load, structure dead load, and highway live load using H20 loading unless other-wise specified plus impact. The highway live load used for analysis purposes shall be either an HS20 truck or equivalent lane loading, whichever is greater, unless a different highway live load is shown in the contract documents. Except as noted, the analysis shall use the loadings and design assumptions in the NYSDOT Standard Specifications for Highway Bridges.
- Details on how the enclosure is assembled, disassembled and moved to a new location on the structure as surface preparation work progresses. Indicate how the dust collector will be included in the containment enclosure. All other pertinent details relating to the containment enclosure shall be included with the working drawings as notes or as written narrative.
- Details on how the use of the enclosure will be coordinated with the Work Zone Traffic Control. Encroachments onto roadways and clearances over waterways and railroads shall be clearly identified.

**A. General.** The containment system includes the cover panels, screens, tarps, scaffolds, supports, and shrouds used to enclose an entire work area. The purpose of the containment is to prevent all debris generated during surface preparation from entering the environment and to facilitate the controlled collection of the debris for disposal.

The containment shall meet the requirements of SSPC-Guide 6, Class 1A. The containment shall have air impenetrable-walls, rigid or flexible framing, fully sealed joints, and resealable entry ways. Negative air shall be achieved by forced air flow. Exhaust air shall be filtered.

Flexible covers for flooring shall be impermeable and will be allowed only if the ground or paved surfaces are smooth enough to vacuum debris. If a smooth surface is not available, rigid materials shall be used for the floor of the enclosure.

**B. Containment Operations.** All abrasive-blast cleaning and paint removal work, and all work associated with the collection of paint waste debris, including the subsequent air blow-down or vacuuming of debris from the steel surfaces on the structure in preparation for painting and inspection, shall be performed inside the containment enclosure.

The Contractor shall attempt to limit workers from entering or exiting the containment enclosure when blast cleaning and paint removal operations are being performed.

**C. Waste Collection.** All waste material that results from abrasive blasting and paint removal operations shall be cleaned up and collected from the floor, walls, and other surfaces inside of the containment enclosure by vacuuming. Sweeping, shoveling, or other mechanical means to remove the

waste materials will not be allowed unless the containment is intact and the vacuuming system is operating. Clean up operations shall be performed daily, prior to inspection, before new paint is applied or before a prolonged work stoppage, such as for weather interruptions.

Prior to disassembly or moving of the paint enclosure, the inside surfaces of the enclosure (walls, floors, ceiling, etc.) shall be cleaned of dust and other spent material by vacuuming. The Contractor shall take all measures necessary to prevent the release of waste material during moving or removal of the containment.

All vacuum equipment that is used for collection and cleanup work shall be equipped with HEPA filters. All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable local, State, and Federal Laws, regulations, and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

**D. Ventilation.** The size of the exhaust-fan system supplied shall be designed to produce an average minimum cross-draft air velocity or an average minimum downdraft air velocity inside the containment enclosure. For enclosures designed with horizontal air flow, the exhaust fan shall have the capacity to produce an average minimum cross-draft velocity of 100 fpm, based on theoretical calculations. For enclosures designed with vertical air flow, the exhaust fan shall have the capacity to produce an average minimum downdraft velocity of 50 fpm, based on theoretical calculations. Forced exhaust air shall flow into dust collectors. The dust collectors shall be used and appropriately sized for the type, size of particulate matter, volume, and velocity of air moved through the containment. All air exhausted from the containment enclosure shall pass through the dust collection system.

Proper operation of the ventilation system shall be maintained after each assembly of the containment and during all phases of work.

**E. Lighting.** Light intensity by natural or artificial means inside the containment enclosure shall be maintained at a minimum of 50 foot-candles on the steel surface. During inspection activities, light shall be maintained at a minimum of 100 foot-candles. Auxiliary lighting shall be provided as necessary. The Contractor shall provide the Engineer with one portable light meter with a scale of 0 to 100 foot-candles. This meter will be returned to the Contractor at the completion of work. All lighting used in the containment shall be explosion-proof.

**F. Containment Performance.** NYSDOT will perform air quality monitoring (AQM) for ambient particulate and lead during abrasive blasting/cleanup. Real-time AQM will be used for all Class A containments. High-volume AQM may be used in addition to real-time AQM. The effectiveness of the containment and accessory equipment in preventing unacceptable levels of particulate and lead emissions will be assessed based on established AQM criteria for both the real-time and high-volume monitoring. Throughout the duration of work, there shall be no visible discharges. If the Engineer observes a visible discharge, the Contractor shall immediately stop work and perform necessary repairs to the containment enclosure or modifications to blast cleaning operations to the Engineer's satisfaction.

The Engineer may direct the Contractor to stop all work activities and require the Contractor to immediately clean up all waste materials within the enclosure when severe weather conditions exist or are predicted. This measure may be exercised when an apparent threat exists that could cause the release of waste material to the surrounding environment, such as high winds or heavy rain.

If the wind velocity causes the containment enclosure to billow or to emit dust, or to otherwise be a hazard in the opinion of the Engineer, the Contractor shall immediately cease work and cleanup all the debris. If severe conditions are predicted, the Contractor shall disassemble the containment enclosure.



**G. Releases From the Containment.** For structures that are located over or adjacent to water, if floating waste materials form on the water surface, they shall be contained from moving upstream or downstream by the use of floating water booms. Floating waste material shall be collected daily, or more frequently.

Any waste material that is released outside the containment enclosure shall be immediately cleaned up using vacuums. Care shall be taken on pavement and other surfaces to collect all waste material so as to prevent it from being redistributed into the air and environment by traffic or other means.

All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable Local, State, and Federal Laws, regulations and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

#### **570-4 METHOD OF MEASUREMENT.**

**570-4.01 Lead-Exposure Control Plan (LECP).** The work under the Lead Exposure Control Plan will be measured for payment on a lump sum basis.

**570-4.02 Medical Testing.** The work under medical testing will be measured for payment on a dollars-cents basis.

The amount shown in the itemized proposal for this work will be considered the price bid even though payment will be made for actual work performed. This amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid.

**570-4.03 Personal-Exposure-Monitoring Sample Analysis.** The work under the personal exposure monitoring sample analysis will be measured for payment on a dollars-cents basis.

The amount shown in the itemized proposal for this work will be considered the price bid even though payment will be made for actual work performed. This amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid.

**570-4.04 Decontamination Facilities.** The quantity to be measured for payment will be in calendar weeks.

**570-4.05 Environmental Ground Protection.** This work will be measured for payment on a lump sum basis.

**570-4.06 Environmental Water Protection.** This work will be measured for payment on a lump sum basis.

**570-4.07 Class B Containment.** This work will be measured for payment on a lump sum basis.

**570-4.08 Class A Containment.** This work will be measured for payment on a lump sum basis.

#### **570-5 BASIS OF PAYMENT.**

**570-5.01 Lead-Exposure Control Plan (LECP).** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

**570-5.02 Medical Testing.** Payment shall include all reasonable and customary costs incurred (based on receipted bills submitted to the Engineer, plus 5% overhead and profit).

No payments shall be made for additional medical tests or laboratory analyses required due to an increase in the blood lead level of any employee above the OSHA threshold.

**570-5.03 Personal-Exposure-Monitoring Sample Analysis.** Payment shall include all reasonable and customary costs incurred (based on receipted bills submitted to the Engineer, plus 5% overhead and profit), for laboratory analysis of exposure monitoring samples.

**570-5.04 Decontamination Facilities.** The unit price bid per week for each facility shall include the cost of all labor, materials, equipment, utility, and disposal charges necessary to satisfactorily complete the work.

**570-5.05 Environmental Ground Protection.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

**570-5.06 Environmental Water Protection.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

**570-5.07 Class B Containment.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

Progress payments will be made based upon the amount of work completed using a daily rate of payment determined from the estimate of work days of cleaning and painting shown in the Contractor's approved progress schedule and the lump sum price bid.

Should the Engineer request a revised progress schedule and use that schedule to establish a new daily rate, the lump sum price bid shall be reduced by the total of the amounts previously authorized for payment, prior to the establishment of the new daily rate.

**570-5.08 Class A Containment.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

Progress payments will be made based upon the amount of work completed using a daily rate of payment determined from the estimate of work days of cleaning and painting shown in the Contractor's approved progress schedule and the lump sum price bid.

Should the Engineer request a revised progress schedule and use that schedule to establish a new daily rate, the lump sum price bid shall be reduced by the total of the amounts previously authorized for payment, prior to the establishment of the new daily rate.

No payment will be made for each calendar day during which there are substantial deficiencies. Substantial deficiencies are defined as: (1) The second occurrence of a visible emission for a cause which has been previously identified and corrected, or (2) air quality monitoring produces unacceptable results as defined in the Department's Air Quality Monitoring (AQM) Protocols.

The nonpayment will be calculated as follows:

$$(\text{Lump Sum Price Bid/Actual \# of Work Days}) \times (\text{\# of Days with Substantial Deficiencies})$$

In addition to the non payment for substantial deficiencies, the costs of any extension of the Air Quality Monitoring beyond the basic monitoring program or random audits defined in the AQM Protocol, which are necessitated by unacceptable AQM results, will also be charged to the Contractor.

Both of these amounts will be deducted from monies due to the Contractor.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
570.01	Lead-Exposure Control Plan	Lump Sum
570.02	Medical Testing	Dollars-Cents

570.03	Personal-Exposure-Monitoring Sample Analysis	Dollars-Cents
570.04	Decontamination Facilities	Calendar Week
570.09nnnn	Environmental Ground Protection	Lump Sum (each structure)
570.10nnnn	Environmental Waterway Protection	Lump Sum (each structure)
570.15nnnn	Class A Containment	Lump Sum (each structure)
570.16nnnn	Class B Containment	Lump Sum (each structure)

NOTE: nnnn denotes serialized pay item.

## SECTION 571 - DISPOSAL OF PAINT REMOVAL WASTE

(Last Revised January 2019)

**571-1 DESCRIPTION.** The work shall consist of managing, accumulating, packaging, labeling, loading, transporting, treating, and disposing paint removal waste.

**571-1.01 Paint Removal Waste.** Paint removal waste consists of removed paint particles combined with material used to remove the paint and any organic or inorganic materials from bridge surfaces, by either bridge washing or blast cleaning operations, without use of any added chemical solvents. All testing of the paint removal waste necessary to satisfy the requirements of the waste transporter or disposal facility shall be the responsibility of the contractor.

Paint removal waste does not include used tyvek suits, respirator filters, tarpaulins or incidental trash. These incidental wastes generated by the Contractor in completing the work are covered by §107-10 *Managing Surplus Material and Waste*.

**A. Hazardous Paint Removal Waste Containing Lead.** This shall apply to spent abrasives, coatings and paint chips removed from steel substrates on bridges designated in the contract documents as being lead-based. This does not include waste containing a mixture of lead and asbestos. Waste containing a mixture of lead and asbestos shall be disposed of in accordance with Section 210 *Removal and Disposal of Asbestos-Containing Material (Buildings, Bridges and Highways)*.

**B. Non-Hazardous Industrial Solid Paint Removal Waste.** This shall apply to spent abrasives and coatings removed from steel substrates on bridges designated in the contract plans as being non-lead-based.

**571-2 MATERIALS.** The Contractor shall use containers or roll-offs acceptable to the Waste Disposal Facility. The capacity of each container shall be clearly marked on each container in an easily visible location.

### 571-3 CONSTRUCTION DETAILS.

**571-3.01 General.** The Engineer will provide the Contractor with the Generator site identification number(s) issued by the USEPA. All paint removal waste shall be deposited and sealed in containers or roll-offs concurrent with generation. The paint removal waste shall be accumulated in clean, dry, weatherproof, watertight containers or roll-offs furnished by the Contractor and shall not be left exposed to the elements at the end of the working shift. All equipment and containers or roll-offs shall meet the requirements of USDOT for transport.

Paint removal waste shall be accumulated, handled, packaged, documented, loaded, transported, treated and disposed in accordance with all applicable Federal and State laws, rules, and regulations.

### 571-3.02 Paint Removal Waste Composition.

**A. Hazardous Paint Removal Waste Containing Lead.** Paint chips are known to contain lead and the combined paint removal waste stream is therefore categorized as hazardous waste. The Department has presumed that the waste will test as hazardous. The Contractor shall ensure that only solid paint removal waste is deposited into the containers or roll-offs. The determination has been made that such waste contains less than 2% by weight of organic material. Disposal facilities may refuse to accept paint removal waste that is different than the Typical Paint Waste Composition. Paint removal waste containing additional contaminants added by the Contractor or by the Contractor's operations shall be the responsibility of the Contractor. All testing of the paint removal waste necessary to satisfy the requirements of the chosen Disposal Facility or Transporter shall be the responsibility of the Contractor.

Provided is typical lead-based paint waste information which provides typical chemical and physical properties of paint removal waste based on previous testing, as follows:

**Lead-Based Paint Waste Profile:** Lead-based paint waste generated by the removal of paint consists of a mixture of abrasive blast media such as boiler slag or steel grit and paint chips. This supplemental information about the waste is provided in accordance with Resource Conservation and Recovery Act (RCRA) regulations. This composition profile does not include waste resulting from removal by chemical strippers for which the resulting waste will contain components of the stripper. Based on the knowledge of the process and the resulting waste material, and on previous testing of typical waste by independent laboratories approved by the NYS Department of health, this composition waste material information has been developed for typical lead-based paint waste.

**Process Generating Waste:** The waste results from removal of lead-based coatings from painted structures, typically steel bridges, by abrasive blasting, manual, shrouded mechanical, or high-pressure (hp) water methods. The North American industry Classification System Code (NAICS) typically assigned for the site is 23731-Highway, Street, and Bridge Construction.

**Composition:** To the Department's knowledge, the waste does not contain PCBs, pesticides, cyanides, organic TCLP constituents, dioxins, asbestos, ozone depleting substances, volatile organics or greater than 1000 ppm halogenated organic compounds. The waste is not a RCRA reactive, corrosive or ignitable, or source-listed or chemical product-listed waste. It is not radiological, etiological, explosive, water reactive, or shock sensitive. The specific composition will vary based on the removal method used, abrasive used, the proportion of paint chips to abrasives and other variables determined by the Contractor's operation. For wastes resulting from any chemical stripping of paint, the Contractor shall consider the components and properties of the stripper and the resulting waste mixture to characterize the waste.

**The waste typically contains the following:**

<u>Removal Method</u>	<u>Approximate %</u>	
	<u>Abrasive</u>	<u>Paint Chips</u>
Boiler Slag (an amorphous mixture of Fe, Al and Ca silicates)	90-95%	5-10%
Steel Grit (% varies by degree of grit recycling)	40-90%	10-60%
No Abrasive (manual, shrouded mechanical and water methods)	0%	100%

**Paint Chips:** Paint chips contain basic lead silico chromate, titanium dioxide, chromate dioxide, magnesium silicate, linseed oil, alkyd resin, fillers, driers, and other miscellaneous materials.

**Other Components:** Water may be present from water used during removal. Iron oxide (rust, mill scale) may be present. Animal waste (i.e., feces, guano, nesting materials, etc.) and dirt/miscellaneous debris may also be potentially present.

**RCRA Metals:** The waste is presumed to contain lead at levels exceeding the regulatory limit of 5 milligrams per liter (approximately 5 ppm) by the Toxicity Characteristic Leaching Procedure (TCLP) test for lead (unless contract documents provided for testing to determine lead toxicity characteristic). Chromium is considered present as an underlying characteristic.

**Typical Physical Characteristics:**

- Physical State – Solid
- Color – Black for boiler slag component, or metallic grey/black for steel grit component.  
Color varies for paint chips.
- Odor – None
- pH – Not Applicable
- Liquid Flash Point – Not Applicable
- Specific Gravity – Approximately 2.7 (boiler slag) and Approximately 7.5 (steel grit)
- Bulk Density – Approximately 1.2 kg/l (boiler slag)  
Approximately 3.6 kg/l (steel grit)
- Free Liquids – None (moisture may be present from water added during removal)

**Consolidated Hazardous Waste Information:** The following consolidated information for hazardous lead-based paint waste can be used in completing the required items needed for its proper shipment and disposal:

- USDOT Shipping Description – RQ Hazardous Waste, Solid, n.o.s. (D008); 9; NA3077; PG III  
n.o.s. = Not Otherwise Specified, PG = Packing Group
- Hazard Label on containers – Class 9
- Placard for shipments exceeding 455 kg or bulk – Class 9
- Hazardous Waste due to the Characteristic Lead Toxicity, Waste Code D008
- Constituents of Concern – Lead and Chromium
- Treatability Group – Non-wastewater
- Treatment Standard – 0.75 mg/L Lead and 0.06 mg/L Chromium by TCLP test
- Reportable Quantity – 4.54 kg or greater
- Markings on Container –  
Hazardous waste, solid, n.o.s. (D008); NA3077  
HAZARDOUS WASTE – Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the Environmental Protection Agency.  
Generator’s Name: NYSDOT Region ( )  
EPA ID Number ( )  
Manifest Document Number ( )  
Accumulation Start Date ( )

USDOT Emergency Response Guidebook Guide: 171, Substances (Low to Moderate Hazard)

**B. Non-Hazardous Industrial Solid Paint Removal Waste.** The Contractor shall ensure that only solid paint removal waste is deposited into the containers or roll-offs. All testing of the paint removal waste necessary to satisfy the requirements of the disposal facility or transporter shall be the responsibility of the Contractor.

**571-3.03 Hazardous Paint Removal Waste Containing Lead - Management Requirements.**

Employees handling hazardous paint removal waste shall be trained in accordance with 6 NYCRR Part 373-3.2(g) in hazardous waste management procedures including hazardous waste accumulation, preparedness and prevention, contingency and emergency procedures. The Contractor’s Preparedness

and Prevention Plan, Contingency Plan and Emergency Procedures, and Personnel Training Records, as required by 6 NYCRR Part 373-1.1(d)(1)(iii), shall be submitted to the Engineer for acceptance prior to the generation of any hazardous waste. Containers in storage shall be inspected on at least a weekly basis in accordance with 6 NYCRR Part 373-3.9(b)-(d).

**571-3.04 Containers and Labeling.** No roll-off shall be filled to a capacity in excess of that marked on the roll-off as the maximum capacity. Once the Engineer determines the quantity within a specific container or roll-off, that container or roll-off shall be properly sealed and not thereafter be tampered with. No additional waste shall be placed in it, nor shall any be removed from it (except for analytical sampling). All containers or roll-offs shall be located in a place secured from traffic and in a manner acceptable to the Engineer. The Contractor shall take measures to prevent the blowing or dispersion of the waste during each loading operation and while being transported.

The Contractor shall label, mark, and placard all containers or roll-offs prior to shipment in accordance with USDOT and NYSDEC regulations. Each container shall have an appropriate label prior to filling with the applicable words identifying its contents as paint removal waste providing the presumed waste classification of hazardous or non-hazardous industrial waste, and indicating the hazard of the contents (RCRA Toxicity). The accumulation start date shall be completed at the time when waste is first deposited into each container. All label markings shall be permanent, printed in English, and displayed on a background of contrasting color un-obscured by other labels or attachments. Labeling shall be located away from other markings that could substantially reduce its effectiveness.

#### **571-3.05 Document Preparation.**

**A. Hazardous Paint Removal Waste Containing Lead.** The Contractor shall prepare and distribute all documentation including the Uniform Hazardous Waste Manifest. The Engineer will sign the Generator's Certification on the Uniform Hazardous Waste Manifest. The LDR (Land Disposal Restricted) certification shall be completed and attached to the manifest, as required by 40 CFR Part 268 *Land Disposal Restrictions*.

**B. Non-Hazardous Industrial Solid Paint Removal Waste.** The Contractor shall prepare and distribute all documentation, including the disposal record forms.

**571-3.06 Paint Removal Waste Transport.** All paint removal waste shall be in transit to the disposal site from the site of generation no later than 45 calendar days unless otherwise approved by the Engineer, but no longer than 90 days. Any additional required shipment information, including manifest number, shall be entered on the container label(s) prior to shipment offsite. The Contractor shall present evidence that the vehicle that will be used for the shipment is permitted to transport the designated waste in accordance with 6NYCRR Part 364.

Conditions for hazardous paint removal waste transporting vehicles to pick up paint waste debris, in bulk, from one or more bridge sites (multiple collection) for delivery to an authorized Treatment, Storage and Disposal Facility (TSDF) include the following:

#### **A. Hazardous Paint Removal Waste Containing Lead.**

- The materials picked up at each site shall be essentially identical in physical and chemical characteristics. No materials, other than paint waste debris, may be included if wastes from several individual generating sites are to be combined on the same truck.
- All of the component shipments are presumed to be D008 hazardous wastes, and disposed as such.
- A manifest is prepared for each generating bridge site. Each manifest shall reflect a bulk shipment, and all manifests being carried by the same transporting vehicle must express the

quantity in pounds. In sum total, the manifests accompanying the shipment shall account for the entire quantity transported.

- All component shipments are intended to be conveyed to the same TSDF, and the TSDF has agreed to accept consolidated bulk loads.
- All component shipments shall have originated at sites where the Department is the waste generator. No loads may be included that were generated at a site for which another agency is the waste generator.
- Measures shall be taken to prevent the blowing or dispersion of the paint removal waste during each loading operation and while being transported.
- The weight of waste shall be provided by the disposal facility.

**B. Non-Hazardous Industrial Solid Paint Waste.** Conditions for non-hazardous waste transporting vehicles to pick up paint waste debris, in bulk, from one or more bridge sites (multiple collection) for delivery to an authorized disposal facility include the following:

- The materials picked up at each site shall be essentially identical in physical and chemical characteristics. No materials, other than paint waste debris, may be included if wastes from several individual generating sites are to be combined on the same vehicle.
- All component shipments are intended to be conveyed to the same disposal facility, and the disposal facility has agreed to accept consolidated bulk loads.
- All component shipments shall have originated at sites where the Department is the waste Generator. No loads may be included that were generated at a site for which another agency is the waste Generator.
- Measures shall be taken to prevent the blowing or dispersion of the waste during each loading operation and while being transported.
- The weight of waste shall be provided by the disposal facility.

**571-3.07 Conditionally Exempt Small Quantity Generator (CESQG) Exemption.** Shipments of non-hazardous paint removal wastes of less than 2000 pounds shipped in a single load may be transported without a waste transporter permit as allowed by the Small Quantity Waste Transporter Exemption at 6 NYCRR Part 364-2.1(b)(5). For activities with generation of hazardous paint removal wastes that meet Conditionally Exempt Small Quantity Generator (CESQG) status (generate less than 220 pounds in any month and store less than 2205 pounds on site at any time), no USEPA ID number is required, the waste can be shipped without a manifest, and a CESQG can self-transport up to 220 pounds of waste in any calendar month to a disposal facility. CESQGs can dispose of their waste at a permitted hazardous waste facility or municipal or industrial solid waste facilities that are permitted to accept that type of waste.

**571-3.08 Hazardous Paint Removal Waste Containing Lead Stabilization.** Treatment of hazardous paint removal waste, as required by Federal regulations, is presumed to require stabilization of the waste such as mixing it with portland cement and water at a permitted Hazardous Waste Treatment or Disposal Facility. The stabilized waste shall meet the treatment standards of the Federal regulations prior to disposal in a permitted Hazardous Waste Disposal Facility.

**571-3.09 Non-Hazardous Industrial Solid Paint Waste Sampling and Analysis.** The Contractor shall conduct all sampling and analysis as required by the designated authorized disposal facility as soon as feasible upon waste generation at each non-hazardous designated bridge. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) as required for the specific analysis to be completed. Each composite sample shall include a minimum of four distinctly different sampling points. Analyses shall be completed at a NYSDOH

Environmental Laboratory Accreditation Program (ELAP) certified laboratory using NYSDEC Analytical Services Protocols (ASPs). The analysis must include, at a minimum, the RCRA heavy metals analysis using the Toxicity Characteristic Leaching Procedure (TCLP) and a total weight analysis. If analytical results indicate that the waste is hazardous, the waste shall be disposed of as such and the hazardous waste pay item shall be used.

#### **571-3.10 Waste Disposal Facility.**

**A. Hazardous Paint Waste Containing Lead.** Prior to generating any hazardous paint removal waste, the Contractor shall provide the Engineer with a letter from a permitted Hazardous Waste Disposal Facility, stating that the Facility has agreed to accept the hazardous waste generated by the work requirements of this contract; is authorized to accept the hazardous waste under the laws of the State of residence; has the required capacity to treat and dispose of the material; and will provide, or assure the ultimate disposal method indicated on the Uniform Hazardous Waste Manifest. The letter shall be signed by a representative of the Disposal Facility who is legally authorized to sign such an agreement.

**B. Non-Hazardous Industrial Solid Paint Waste.** Prior to generating any non-hazardous paint removal waste, the Contractor shall provide the Engineer, in writing, the name and location of the permitted solid waste management facility selected for disposal.

#### **571-4 METHOD OF MEASUREMENT.**

**571-4.01 Hazardous Paint Waste Containing Lead.** The quantity of paint removal waste to be measured for payment will be in net pounds of waste disposed of, based on disposal facility weight tickets of the waste as manifested, not including the weight of the containers.

**571-4.02 Non-Hazardous Industrial Solid Paint Waste.** The quantity of paint removal waste to be measured for payment will be in net pounds of waste disposed of, based on disposal facility weight tickets of the waste as picked up from the site, transported and received at the facility,, not including the weight of the containers.

#### **571-5 BASIS OF PAYMENT.**

**571-5.01 Hazardous Paint Waste Containing Lead.** The unit price bid per pound of paint removal waste shall include the cost of all labor, materials, equipment, sampling, testing, and fees necessary to complete the work based on the assumption that treatment by stabilization will satisfy the applicable Federal regulations. Only waste for which manifest copies (not applicable for CESQG exemption) and weight ticket(s) are returned to the Engineer by the Contractor and Disposal Facility will be authorized for payment. If the Department is fined or penalized as a result of the Contractor's performance or lack thereof, in addition to other remedies the Department may possess, said fine or penalty will be deducted from monies due the Contractor.

**571-5.02 Non-Hazardous Industrial Solid Paint Waste.** The unit price bid per pounds of paint removal waste shall include the cost of all labor, materials, equipment, sampling, testing, and fees necessary to complete the work. Only waste for which weight ticket(s) are returned to the Engineer by the Contractor and Disposal Facility will be authorized for payment. If the Department is fined or penalized as a result of the Contractor's performance or lack thereof, in addition to other remedies the Department may possess, said fine or penalty will be deducted from monies due the Contractor.

*Payment will be made under:*



Item No.	Item	Pay Unit
571.03	Disposal of Hazardous Paint Removal Waste Containing Lead	Pound
571.04	Disposal of Non-Hazardous Industrial Solid Paint Removal Waste	Pound

## SECTION 572 - STRUCTURAL STEEL PAINTING: SHOP APPLIED

(Last Revised January, 2021)

**572-1 DESCRIPTION.** This work shall consist of preparing and painting new steel surfaces in a permanent facility, enclosure, or building, with four walls to grade and a roof, where surface preparation and painting activities are conducted in an environment not subject to outdoor weather conditions and/or blowing dust. All painting work, except field touchup and bolt painting, shall be conducted inside this facility. See special note entitled “*Structural Painting Details*” for the description and requirements of serialized items.

### 572-2 MATERIALS

**572-2.01 Paints.** Paints shall meet the requirements of §708-01 Structural Steel Paints – Class 1, and shall appear on the Department’s Approved List, “Structural Steel Paints - Class 1”. All new paint applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field components of the structure.

**A. Shelf Life.** The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinner shall be the manufacturer’s recommendation or 3 years from the date of manufacture, whichever is less, and a maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer’s name, batch number, color, paint name, and date of manufacture.

**B. Paint Storage.** Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

**C. Color.** Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The colors of the primer, stripe coat, and intermediate coat will be the Contractor’s option. The color of the finish coat shall be as specified in contract documents.

**D. Data Sheets.** The Contractor shall supply the Department’s representative with the paint manufacturer’s material safety data sheets for each paint to be applied. The material safety data sheets shall be delivered to the Department’s representative a minimum of five work days prior to beginning of work. The Department’s representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 Approved List.

**572-2.02 Abrasive for Blast Cleaning.** Abrasive material for blast cleaning shall be selected by the Contractor. Silica sand and other types of nonmetallic abrasive containing more than one percent free silica, by weight, will not be allowed. The abrasive blasting shall produce an angular anchor profile suitable for the paint system to be applied.

**572-2.03 Paint Inspection Equipment.** Prior to the start of work, the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Painting Council, surface preparation specification, SSPC-SP 10 - *Near-White Metal Blast Cleaning*.
2. One bound copy of the Steel Structures Painting Council, surface preparation specification, SSPC SP-1 - *Solvent Cleaning*.
3. One bound copy of the most current Steel Structures Painting Council Pictorial Standards, SSPC-VIS 1, *Guide and Reference photographs for steel surfaces prepared by dry-abrasive blast cleaning*.
4. One bound copy of the Steel Structures Painting Council method SSPC-PA2, Paint Application Specification No. 2 - *Measurement of Dry Film Thickness With Magnetic Gages*.
5. One copy of ASTM D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
6. One copy of ASTM D4285 Test Method for Indicating Oil or Water in Compressed Air
7. One Air Thermometer, pocket type, 10°F to 110°F.
8. One non-contact Infrared Thermometer, 10°F to 110°F.
9. One Contact Thermometer, 10°F to 110°F.
10. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
11. Two Wet-Film Thickness Gages, Prong-Type, capable of measuring 1 to 10 mils in 1 mil increments.
12. Psychrometer and US Weather Bureau Psychrometric Tables.
13. Profile micrometer with extra coarse replica tape.

All equipment will be returned to the Contractor upon completion of the work.

**572-3 CONSTRUCTION DETAILS.** All structural steel members and other miscellaneous steel items shall be cleaned and painted as per contract documents.

The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work completed while the Engineer has been restricted from access, shall be recleaned and repainted at no additional cost to the State.

**572-3.01 Quality Control Plan.** The Contractor shall provide the Engineer with a copy of the Contractor's Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor's QC personnel to ensure compliance. The QCP shall at a minimum, include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor's QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification

The Contractor shall provide daily reports to the Engineer upon request. The reports shall be submitted no later than 24 hours following the completion of the day's work.

## 572-3.02 SURFACE PREPARATION.

### A. Abrasive Blast Cleaning.

**1. Atmospheric Conditions.** Abrasive blast cleaning operations shall not be conducted under the following conditions:

- a. The relative humidity exceeds 85%.
- b. When the substrate is damp or covered by frost.
- c. The surface temperature is less than 5°F above the dew point.

**2. Solvent Cleaning.** Before abrasive blast cleaning begins, steel shall be solvent cleaned of all deposits of oil, grease, dirt, salt, or other contaminants by methods specified in SSPC-SP1, Solvent Cleaning.

**3. Steel Cleanliness and Profile.** All structural steel surfaces to be painted shall be abrasive-blast cleaned in accordance with SSPC-SP10, *Near-White Metal Blast Cleaning*. All abrasive blast cleaning and painting shall be performed at the same facility.

The anchor profile shall be measured in accordance with ASTM D4417, Method C. The Contractor shall ensure that the anchor profile is within the range indicated on the paint manufacturer's data sheets. The profile shall, at a minimum, be measured once per shift and three times in various locations for every 2150 square feet prepared, unless otherwise ordered by the Engineer. The anchor profile shall not exceed 3 mils.

All fins, tears, slivers, burred and sharp edges that are present or occur during the blasting operation shall be removed by grinding, and then the area shall be reblasted to provide the required profile.

**4. Equipment.** All equipment and compressors used in the cleaning operation shall be equipped with filters and traps to prevent moisture, oil, and other contaminants from being deposited on clean surfaces. The air cleanliness shall be verified by the Contractor with the white blotter test in accordance with ASTM D4285 at least once per shift for each compressed air system.

**B. Cleaning Area.** The area cleaned shall be limited to that which can be cleaned and prime coated within an 8-hour period. Cleaned areas shall be approved by the Engineer prior to priming. Areas that exhibit flash rusting within the 8-hour period shall be recleaned.

**C. Visual Standards.** After abrasive blasting is completed, cleaned surfaces shall be compared to SSPC-Vis 1, "Guide and Reference Photographs for Steel Surfaces Prepared By Dry Abrasive Blast Cleaning" Pictorial Standards as applicable. All surfaces shall be free of blasting products and other residues when blasting operations are completed. Surfaces shall be cleared of all foreign matter by means of oil-free, moisture-free, compressed air or vacuum systems.

**572-3.03 PAINTING.** The Contractor shall apply three full coats and a stripe coat of paint to all surfaces cleaned to SP-10. In addition, all cleaned steel surfaces within 6 feet from a bridge joint shall receive an additional coat of intermediate paint, resulting in four coats of paint in these areas. The paint shall be applied in the following order: primer, intermediate, stripe, and the finish coat. Damage resulting from fabrication, handling and storage in the shop shall be restored before leaving the shop. Painted steel shall not be placed outside the shop until all paint coats have dried "through / to-handle" or "minimum time to recoat" per paint manufacturer's recommendations, whichever is greater.

Unless otherwise noted, the contractor shall adhere to the procedures and methods for application as described in SSPC-PA 1, Section 7.

**A. Atmospheric Conditions.** Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer's data sheets is more restrictive, the manufacturer's range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is dry.

Paint shall not be applied when the relative humidity is more than 85% or the receiving surface is less than 5°F above the dew point temperature. If the manufacturer's data sheets have a more restrictive range then they shall be followed.

**B. Paint Mixing.** All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use.

**C. Solvents and Thinners.** Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205 for Zinc-Rich Primers. Intermediate and finish coats shall not be thinned where the resulting VOC level exceeds the maximum allowable Part 205 limit for Industrial Maintenance Coatings. The manufacturer's data sheets shall advise the Contractor and Engineer of the maximum amount of thinner allowed.

Use of unauthorized thinners or using excess amounts of thinners is prohibited. Any area where unauthorized solvents or thinners are used shall be recleaned and repainted at no additional cost to the State.

**D. Paint Application.** Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray, brush, or roller, unless otherwise indicated by the contract documents. All paint shall be applied so as to produce a uniform, even coating free of runs, sags, drips, ridges, or other defects. Roller nap shall be limited in accordance with the paint manufacturer's recommendation. Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating without leaving fibers in the coating.

All steel surfaces that will be in contact with concrete shall not be painted. Priming shall begin only after all welding and fabrication work is completed.

**E. Stripe Coat.** A stripe coat shall extend a minimum of 1 inch away from the following surfaces: all welds, rivets, bolts, nuts, edges of plates and structural members, angles, bearings, lattice pieces or other shapes, corners, and crevices. To provide contrast, paint for stripe coating shall be a different color than the receiving surface. The stripe coat shall use the intermediate paint and be applied after the intermediate coat. The stripe coat shall be brush applied without being thinned. The stripe coat will be applied in accordance with manufacturer's recommendations, with particular attention to the film thickness, recoat window, and cure schedule. Areas near bridge joints that are to receive an additional coat of intermediate paint shall also receive a stripe coat where necessary as described above.

A stripe coat shall not be applied to any slip critical surfaces.

**F. Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness as directed by the range listed on the paint manufacturer's data sheets. The dry-film thickness (DFT) shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - *Measurement of Dry Film Thickness with Magnetic Gages*, using a Type 2 fixed probe magnetic gages. Dry film thickness gauges shall be calibrated over a blasted, approved surface on the structure using two NIST traceable shims as described in the "two point calibration adjustment" section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable. DFTs of the

intermediate and finish coats shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT reading. An average DFT value shall be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.

Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry-film thickness required. The top coating must be performed within the paint manufacturer's specified recoat window.

The Engineer may require any area exceeding the manufacturer's recommended dry-film thickness to be blast cleaned to the SP-10 condition.

***Slip Critical Connections.*** The policy for coating slip-critical contact surfaces is specified in the New York State Steel Construction Manual. All metal to metal, slip-critical contact surfaces shall not be painted unless specified in the Contract Documents and allowed by the New York State Steel Construction Manual.

***G. Painting Schedule.*** Primer shall be applied to approved, abrasive-blasted surfaces within 8 hours of the final cleaning operation. If the Contractor fails to apply primer to the surface within 8 hours of cleaning, the surface shall be restored in accordance with the SP-10 requirements, at no additional cost to the State.

To prevent intercoat adhesion failure, recoating must be performed within the manufacturer's recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to recoat within the specified time period, the surface to be painted shall be cleaned and abraded, in accordance with manufacturer's recommendations, to ensure adhesion of the following coat at no additional cost.

If the steel has become dirty between coats, the Contractor shall wash the structure at no additional cost to the State.

Manufacturer's recommendations shall be observed for cure to handle, and cure to top coat schedules.

***H. Stenciling.*** The following information shall be stenciled on at least one steel element or on the inside web of a fascia member coated under this specification, unless otherwise directed by the Engineer:

1. Month and year of completion
2. Contract number
3. SP10
4. Name of Paint Manufacturer
5. Name of Shop that performed painting
6. Primer, Intermediate, and Finish coat names

The stenciled lettering should be approximately 6 inches in height and be a contrasting paint color to the top coat.

**572-3.04 Field Painting.** The only field work allowed is touch-up work after steel erection and subsequent concrete placement has been completed. All field painting shall be done at no additional cost to the State. All the requirements of this specification shall apply to field painted material with the following modifications:

***A. Hardware.*** Bolt heads, washers, nuts, bolt thread extensions, and other miscellaneous steel surfaces not painted in the shop shall be cleaned as per SSPC SP-1 and painted after the bolts have

been installed and accepted. Abrasive blasting of the bolts is not required. Any dye present on galvanized hardware shall be cleaned in accordance with manufacturer’s recommendation prior to painting. The Contractor shall submit the dye-cleaning procedure to the Engineer five days prior to cleaning.

**B. Surface Preparation of Damaged Areas.** All visible dirt, grease, and other foreign matter shall be removed first by pressure washing and solvent cleaning as per SSPC SP-1 as needed. Areas exhibiting damaged or deteriorated paint not extending to the steel surface shall be hand or power-tool cleaned as necessary to remove damaged or deteriorated, loosely adhered paint. Loosely adhered paint will lift when scraped with a dull putty knife. All edges of paint surrounding the repair area shall be tightly adherent and feathered. These edges and the surrounding painted surfaces to receive a (repair) topcoat(s) shall be abraded to provide a suitable anchor profile for the paint. Areas that exhibit damage of the paint system down to the steel surface shall be cleaned with power tools to SSPC SP-11 and shall exhibit a suitable anchor profile for the primer paint. All power and blasting tools will be vacuum-sealed units. All surrounding steel that has been previously painted in the shop shall be protected from damage during cleaning operations. Repairs shall be smoothly transitioned into surrounding new paint.

**C. Application.** Application shall be made by brush and roller only. Areas of steel exhibiting damage not extending down to the steel surface shall receive two coats of paint: intermediate and finish coat. Damage extending to the steel surface shall receive three coats of paint: primer, intermediate and finish coat. These coats of paint shall be applied at a dry film thickness as recommended by the paint manufacturer for such (repair) application.

**572-4 METHOD OF MEASUREMENT**

**572-4.01 Shop Applied – Square Feet.** The measurement of this item will include the area requiring surface preparation and painting to the nearest whole square foot.

**572-4.02 Shop Applied – Lump Sum.** The work under this item will be measured on a lump sum basis, per structure.

**572-5 BASIS OF PAYMENT.** The unit or lump sum price bid shall include the cost of all labor, materials, and equipment necessary to complete the work.

Progress payments will be made for 80% of total payment quantity upon delivery of shop painted steel to the job site. Shop painted steel will be considered properly painted only when accompanied by the Engineer’s or Inspector’s written certification. The remaining 20% of payment will be made upon completion of cleaning and field painting all bolt heads, nuts, washers, bolt thread extensions, and damaged areas.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
572.01nnnn	Structural Steel Painting: Shop Applied	Square Foot
572.02nnnn	Structural Steel Painting: Shop Applied	Lump Sum

**NOTE:** nnnn denotes a serialized pay item.

**SECTION 573 - STRUCTURAL STEEL PAINTING: FIELD APPLIED - TOTAL REMOVAL**

(Last Revised January, 2021)

**573-1 DESCRIPTION.** This work shall consist of pressure washing, abrasive blast cleaning to remove all paint, rust, rust scale, mill scale, corrosion producing contaminants, and other foreign matter, and painting structural steel surfaces. See Special Note entitled *Structural Painting Details* for the description and requirements for serialized items.

## **573-2 MATERIALS**

**573-2.01 Paints.** Paints shall meet the requirements of §708-01 *Structural Steel Paints – Class 1*, and shall appear on the Department’s Approved List, ‘Structural Steel Paints – Class 1’. All new paint to be applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field painted components of the structure.

**A. Shelf Life.** The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinners shall be per manufacturer’s recommendations or 3 years from the date of manufacture, whichever is less, and a maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer’s name, batch number, color, paint name, and date of manufacture.

**B. Paint Storage.** Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

**C. Color.** Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The colors of the primer, stripe coat, and intermediate coat will be the Contractor's option. The color of the finish coat shall be as specified in contract documents.

**D. Data Sheets.** The Contractor shall supply the Department’s representative with the paint manufacturer’s material safety data sheets for each paint component to be applied. The material safety data sheets shall be delivered to the Department’s representative a minimum of five work days prior to beginning of work. The Department’s representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 Approved List.

**573-2.02 Water for Washing.** Water for pressure washing shall be potable water. Any detergent or soluble salt remover used must receive approval by the paint manufacturer and the Materials Bureau. Water shall not be recycled.

**573-2.03 Abrasive for Blast Cleaning.** Abrasive blast media for blast cleaning shall be recyclable, ferrous metallic, abrasive grit. All new metallic abrasive shall be in compliance with the specifications of SSPC-AB 3 Ferrous Metallic Abrasive. All ferrous metallic abrasive used shall be recycled and cleaned in accordance with SSPC-AB 2. The Contractor shall select the size, blend, and hardness of the abrasive to produce an angular anchor profile of a recommended depth as indicated on the manufacturer’s data sheets.

All ferrous metallic abrasive arriving on the job site shall be new, and invoices shall be submitted for acceptance. All recycling equipment shall arrive empty and clean.

**573-2.04 Paint Inspection Equipment.** Prior to the start of work the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Painting Council surface preparation specification, SSPC SP-1 – *Solvent Cleaning*.
2. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 10 – *Near-White Metal Blast Cleaning*.
3. One bound copy of the most current Steel Structures Painting Council Pictorial Standards, SSPC-VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*.
4. One bound copy of the Steel Structures Painting Council specification SSPC-PA2, Paint Application Specification No. 2 - Measurement of Dry Film Thickness With Magnetic Gages.
5. One bound copy of Steel Structures Painting Council specification SSPC AB-2 *Specification for Cleanliness of Recycled Ferrous Metallic Abrasives*.
6. One bound copy of Steel Structures Painting Council specification SSPC AB-3 *Specification for Newly Manufactured or Re-Manufactured Steel Abrasive*.
7. One copy of ASTM D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
8. One copy of ASTM D4285 Test Method for Indicating Oil or Water in Compressed Air.
9. One Air Thermometer, pocket type, 10°F to 110°F.
10. One noncontact Infrared Thermometer, 10°F to 110°F.
11. One Contact Thermometer, 10°F to 110°F.
12. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
13. Two Wet-Film Thickness Gages, Prong-Type, capable of measuring 1 to 10 mils in 1 mil increments.
14. Psychrometer and US Weather Bureau Psychrometric Tables.
15. Profile micrometer with extra coarse and extra coarse plus replica tape.

All equipment will be returned to the Contractor upon completion of the work.

**573-3 CONSTRUCTION DETAILS.** The Contractor shall clean and paint all structural steel members, railings, downspouts, and other miscellaneous steel items as indicated in the contract documents.

The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work done while the Engineer has been restricted from access, shall be recleaned and repainted, at no additional cost to the State to the State.

**573-3.01 Quality Control Plan.** The Contractor shall provide the Engineer with a copy of the Contractor's Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor's QC personnel to ensure compliance. The QCP shall minimally include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor's QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification



The Contractor must provide daily reports to the Engineer at the conclusion of cleaning work and painting work and prior to inspection of such work by the Engineer. Reports at the conclusion of cleaning and painting work shall include all pertinent information listed above that relate to such work and shall be in a format previously agreed to under the QCP.

**573-3.02 Surface Preparation.** Steel surfaces shall be prepared for painting by a combination of pressure washing, solvent cleaning, and abrasive blast cleaning.

Pressure washing shall be performed first, followed by abrasive blast cleaning to remove all paint, rust, rust scale, and mill scale, as per SSPC SP-10, *Near-White Metal*. If heavy deposits of rust and scale are present, they shall be removed by hand or power tool prior to pressure washing. Deposits of bird droppings taller than 1/2 inch shall be removed prior to pressure washing.

**A. Pressure Washing and Solvent Cleaning.** All steel surfaces to be painted shall be pressure washed, using an operating pressure range of 1800 to 2000 psi, a minimum flow of 3.5 gal/minute, and a water temperature of 185°F to 200°F. The nozzle shall be held at a distance of 6 to 12 inches from the steel surface. Pressure washing shall only be allowed when ambient air temperatures are greater than 40°F and rising. In no case will pressure washing be conducted when spent wastewater could freeze on roadway or bridge surfaces or in any other way create a hazardous situation. The washing is intended to remove contaminants from the surface, not to remove tightly adhered paint. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1, *Solvent Cleaning*. The areas shall be pressure washed again following this cleaning.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil, grease, animal waste, salts, and other debris

A containment shall be suspended around and beneath the work area during pressure washing. The containment for pressure washing is intended to capture solid paint chips and other solid debris that may become dislodged from washing operations. Unless otherwise noted, spent wash water will not require collection and will be allowed to fall to the underlying ground or waterway, provided that the other requirements of this specification are met.

Special note, Structural Painting Details, will provide scheduling requirements for washing a structure over a body of water. Spent wash water over a public water supply or the New York City watershed shall be collected and diverted to the adjoining land mass.

If steel surfaces become contaminated or 7 calendar days elapse between washing and abrasive blasting cleaning, they shall be rewashed at no additional cost to the State.

The surface shall be allowed to dry before subsequent abrasive blast cleaning begins.

**B. Abrasive Blast Cleaning.**

**1. Atmospheric Conditions.** Blast cleaning operations shall not be conducted under the following conditions:

- a. The relative humidity exceeds 85%.
- b. When the substrate is damp or covered by frost.
- c. The surface temperature is less than 5°F above the dew point.

**2. Steel Cleanliness and Profile.** All structural steel surfaces shall be blast cleaned to SSPC SP-10, *Near-White Metal*.

The anchor profile shall be measured in accordance with ASTM D4417, Method C. The Contractor shall ensure that the anchor profile is within the range indicated on the paint manufacturer's data sheets. The profile, at a minimum, shall be measured five times in various locations every 2000 square feet prepared and once per work shift, unless otherwise ordered by

the Engineer. The anchor profile shall not exceed 4 mils unless approved by the Engineer. The Engineer may approve a profile greater than 4 mils if an area is severely corroded or pitted. If the Contractor exceeds the 4 mils profile, the Contractor will be required to measure the profile using extra-coarse-plus replica tape and apply an additional mist coat of primer in accordance with manufacturer's recommendations to obtain a minimum 2 mils film build over the profile peaks, at no additional cost to the State.

All fins, tears, slivers, flame-cut edges, burred and sharp edges that are present or occur during the blasting operation shall be removed by grinding, and then the area shall be reblasted to provide the required profile.

Special attention shall be given to the edges of beam flanges, angles and plates, bearings, rivets, the heads of nuts and bolts, structural steel surrounding bridge joints, and similar surfaces that are marginally accessible and difficult to clean.

Upon completion of blast cleaning and prior to inspection, the containment shall be vacuumed and the cleaned surfaces shall be free of all blasting products and paint debris. Surfaces shall be free of all abrasive prior to inspection. Surfaces shall be cleared of all foreign matter by means of oil-free, moisture-free, compressed air or vacuum systems

All cleaned surfaces will be inspected by the Engineer prior to painting. Any areas that are painted before being inspected shall be cleaned and restored to the SP-10 standard and repainted at no additional cost to the State. If the cleaned surface begins to rust or becomes contaminated in any matter prior to applying primer, the surface shall be restored to SP-10 standard.

**3. *Steel Grit.*** The recyclable abrasive shall be cleaned of all paint, chips, rust, mill scale, and other foreign material after each use, prior to reuse. The cleanliness of the recycled abrasive during use shall be confirmed in accordance with SSPC-AB2. The Contractor shall execute, record, and provide the Engineer results of the nonabrasive residue test, water soluble test, and oil content test daily. The Engineer may be present during this testing. The Contractor shall also execute and provide lead content test results weekly. All equipment used for cleaning abrasive shall be specifically designed for this purpose and accepted by the Engineer.

The Contractor shall maintain a balance in the size distribution of the abrasive work mix for the duration of the abrasive blasting operations to maintain a uniform profile across the surfaces to be blasted. The work mix shall not be predominantly coarse or fine, and shall be maintained through proper removal of expended abrasive and its timely replenishment.

**4. *Protection of Newly Painted Surfaces.*** Throughout abrasive blast cleaning work, care shall be taken to protect newly painted surfaces from the cleaning operations. Tarps, covers, or other devices shall be used to protect new paint from contamination or damage. Contaminated areas of new paint shall be cleaned as necessary prior to the next coat of paint. Damaged paint shall be blast cleaned to the required condition, and then repainted at no additional cost to the State.

**5. *Vacuuming.*** After cleaning operations are completed, all debris generated by the cleaning work shall be removed by vacuuming using HEPA-filtered vacuums. A HEPA filter shall be defined as a filter that is at least 99.97% efficient for particles that are 0.3µm in diameter, or larger.

**6. *Equipment.*** All equipment and compressors used in the cleaning operation shall be equipped with filters and traps to prevent moisture, oil, and other contaminants from being deposited on clean surfaces. The air cleanliness shall be verified by the Contractor with the white blotter test in accordance with ASTM D4285 at least once per shift for each compressed air system.

**7. *Cleaning Area.*** The area cleaned shall be limited to that which can be cleaned, inspected and prime coated within a 10-hour period. Cleaned areas shall be inspected by the Engineer prior to

priming. Areas that exhibit flash rusting or fail to meet the local standard prior to painting shall be re-cleaned to the approved standard at no additional cost to the State.

**C. Visual and Project Standards.** The Contractor shall prepare at least one project cleaning standard for each representative area on the structure that is being prepared for painting. Multiple standards may be required if the cleaned steel differs significantly from the photographic standards due to surface conditions, or other factors such as distance of the standard from the work area.

The prepared cleaning standard shall conform to SSPC VIS 1, "*Guide and Reference Photographs for Steel Surfaces Prepared By Dry Abrasive Blast Cleaning*" Pictorial Standard as applicable, and shall be approved by the Engineer before the start of general cleaning work. Each cleaning standard shall be at least 12 x 12 inches in size, and shall be located in an area of the structure that is easily accessible, and approved by the Engineer. The Contractor shall protect the work standard from corrosion and contamination throughout the duration of work by applying a clear coat of polyurethane. At the completion of cleaning work, the cleaning standard shall be cleaned and painted. If the project standard becomes deteriorated, or otherwise ineffective, it shall be reestablished at no additional cost to the State. In case of a dispute over the visual standard, the written standard shall take precedence.

**573-3.03 PAINTING.** The Contractor shall apply three full coats of new paint and one stripe coat to all surfaces cleaned to SP-10. The paint shall be applied in the following order: primer, intermediate coat, stripe coat, and the finish coat. All steel surfaces within 6 feet of a bridge joint shall receive an additional full coat of intermediate paint.

**A. Atmospheric Conditions.** Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer's data sheets is more restrictive, the manufacturer's range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is absolutely dry.

Paint shall not be applied when the relative humidity is more than 85% or the surface temperature is less than 5°F above the dew point. If manufacturer's requirements are more restrictive then they shall be followed. No paint shall be applied during rain or when rain is forecast to occur by the National Weather Service for the project location during painting operations. All painted surfaces shall be protected from direct exposure to rain for the time interval recommended by the paint manufacturer for proper cure. The Contractor shall observe the dew point and humidity restrictions listed on the manufacturer's data sheets.

If an epoxy coating is exposed to temperatures or humidity conditions outside of the manufacturer's recommended values prior to cure, all affected surfaces shall be visually examined for greased or oily surfaces which may have formed. The Engineer may require the Contractor to use a commercially available amine blush test kit at locations chosen by the Engineer. If testing indicates the presence of an amine blush or if there is any oily film on the surface, the surfaces shall be cleaned and prepared for topcoating in accordance with paint manufacturer's recommendations at no additional cost to the State.

**B. Paint Mixing.** All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use.

**C. Solvents and Thinners.** Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205 for Zinc-Rich Primers. Intermediate and finish coats shall not be thinned where the resulting VOC level exceeds the maximum allowable Part 205

limit for Industrial Maintenance Coatings. The manufacturer's data sheets shall advise the Contractor and Engineer of the maximum amount of thinner allowed.

Use of unauthorized thinners or using excess amounts of thinners is prohibited. Any area where unauthorized solvents or thinners are used shall be recleaned and repainted at no additional cost to the State. All thinning shall be performed in the presence of the Engineer.

**D. Paint Application.** Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray or brush and roller, unless otherwise indicated by the contract documents. All paint shall be applied so as to produce a uniform, even coating free of runs, sags, drips, ridges, or other defects. Roller nap shall be limited in accordance with the paint manufacturer's recommendation. Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating without leaving fibers in the coating.

Protection against paint spatter, spillage, wind blown paint, or similar releases of paint shall be provided. Covers, tarps, mesh, and similar materials shall be placed around the work area to protect public and private property, pedestrian, vehicular or marine traffic, all portions of the bridge, highway appurtenances, waterways, and similar surrounding areas and property, upon, beneath, or adjacent to the structure. The use of spray equipment for paint application shall be allowed within containments provided that the aforementioned protection against paint release is provided, all equipment used (including tarps, mesh and similar materials) meets all safety requirements for such enclosed use with paint spraying, and all OSHA requirements for safety and ventilation are met.

**E. Stripe Coat.** A stripe coat shall extend a minimum of 1 inch away from the following surfaces: all welds, rivets, bolts, nuts, edges of plates and structural members, angles, bearings, lattice pieces or other shapes, corners, and crevices. Areas near bridge joints that are to receive an additional coat of intermediate paint shall also receive a stripe coat where necessary as described above. To provide contrast, paint for stripe coating shall be a different color than the receiving surface. The stripe coat shall use the intermediate paint and be applied after the intermediate coat. The stripe coat shall be brush applied without being thinned. The stripe coat will be applied in accordance with the manufacturer's recommendations, with particular attention to the film thickness, recoat window and cure schedule.

**F. Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness as directed by the range listed on the paint manufacturer's data sheets. The dry-film thickness shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - *Measurement of Dry Film Thickness with Magnetic Gages*, using a Type 2 fixed probe magnetic gages. Dry film thickness gauges shall be calibrated over a blasted, approved surface on the structure using two NIST traceable shims as described in the "two point calibration adjustment" section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable. DFTs of the intermediate and finish coats shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT reading. An average DFT value shall be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.

Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry film thickness required. The top coating must be performed within the paint manufacturer's specified recoat window.

The Engineer may require any area exceeding the manufacturers recommended dry-film thickness to be blast cleaned to the SP-10 condition.

**G. Painting Schedule.** Primer shall be applied to approved, abrasive-blasted surfaces according to section §573-3.02, B. 7 of this specification.

Each area as defined by §573-3.02, B. 7 shall receive an intermediate coat of paint within 72 hours after priming. To prevent intercoat adhesion failure, the topcoat shall be applied within the manufacturer's recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to topcoat within the specified time period, the surface to be painted shall be cleaned and abraded, in accordance with manufacturer's recommendations, to ensure adhesion of the following coat at no additional cost.

If the steel has become dirty between coats, the Contractor shall wash the bridge again at no additional cost to the State.

Manufacturer's recommendations shall be observed for cure to handle, and cure to top coat schedules.

**H. Stenciling.** After the finish coat of paint has cured, the Contractor shall stencil the following information on the inside web of the fascia member, near the BIN plate, unless otherwise directed by the Engineer:

1. Month and year of completion
2. Contract number
3. SP10
4. Name of Paint Manufacturer
5. Name of Contractor
6. Primer, Intermediate, and Finish coat names

The stenciled lettering should be approximately 6 inches in height and be a contrasting paint color to the top coat.

#### **573-4 METHOD OF MEASUREMENT**

The work under this item will be measured on a lump sum basis per structure.

#### **573-5 BASIS OF PAYMENT**

The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including the cost of providing protection against damage to public and private property during surface preparation and paint application. Payment for the containment, collection and disposal of dust and paint waste generated by surface preparation work shall be paid for separately.

Progress payments will be based on the percentage of steel cleaned and painted. No more than 60% of the quantity will be paid for surface preparation and priming. The remaining amount will be paid following the satisfactory completion of work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
573.01nnnn	Structural Steel Painting Field Applied - Total Removal	Lump Sum

**NOTE:** nnnn denotes a serialized pay item.

### **SECTION 574 - STRUCTURAL STEEL PAINTING: OVERCOATING AND LOCALIZED**

(Last Revised January, 2021)

**574-1 DESCRIPTION.** This work shall consist of pressure washing and power-tool or vacuum-blast cleaning of damaged paint areas and corroded structural steel surfaces, and painting surfaces described in

contract documents. See Special Note entitled *Structural Painting Details* for the description and requirements of serialized items.

## **574-2 MATERIALS**

**574-2.01 Paints.** Paints shall meet the requirements of §708-02 *Structural Steel Paints Class 2* and shall appear on the Department's Approved List, Structural Steel Paints – Class 2 for localized and overcoat painting, or on the Structural Steel Paints – Class 1 Approved List for localized painting only.

All new paint to be applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field painted components of the structure.

**A. Shelf Life.** The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinners shall be per manufacturer's recommendations or 3 years from the date of manufacture, whichever is less, and a maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer's name, batch number, color, paint name, and date of manufacture.

**B. Paint Storage.** Paint in storage shall be protected from damage and maintained in accordance with manufacturer's recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

**C. Color.** Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The color of the finish coat shall be as specified in contract documents. The color of the other coats will at the Contractor's option.

**D. Data Sheets.** The Contractor shall supply the Department's representative with the paint manufacturer's material safety data sheets for each paint to be applied. The material safety data sheets shall be delivered to the Department's representative a minimum of five work days prior to beginning of work. The Department's representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 or Class 2 Approved List, as applicable.

**574-2.02 Water for Washing.** Water for pressure washing shall be potable water. Any detergent or soluble salt remover used must receive approval by the paint manufacturer and the Materials Bureau. Water shall not be recycled.

**574-2.03 Abrasive for Blast Cleaning.** Abrasive material for blast cleaning shall be selected by the Contractor. Silica sand and other types of nonmetallic abrasive containing more than one percent free silica, by weight, will not be allowed. The abrasive blasting shall produce an angular anchor profile suitable for the paint system to be applied.

**574-2.04 Paint Inspection Equipment.** Prior to the start of work the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Painting Council surface preparation specification, SSPC SP-1 – *Solvent Cleaning*.
2. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 11 – *Power Tool Cleaning to Bare Metal*.
3. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 10 – *Near-White Metal Blast Cleaning*.

4. One bound copy of the Steel Structures Painting Council pictorial standards, SSPC-VIS 3, *Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning*.
5. One bound copy of the most current Steel Structures Painting Council pictorial standards, SSPC-VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*.
6. One bound copy of the Steel Structures Painting Council method SSPC-PA2, *Paint Application Specification No. 2 - Measurement of Dry Film Thickness With Magnetic Gages*.
7. One copy of ASTM D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
8. One copy of ASTM D4285-83 (1999) Test Method for Indicating Oil or Water in Compressed Air.
9. One Air Thermometer, pocket type, 10°F to 110°F.
10. One noncontact Infrared Thermometer, 10°F to 110°F.
11. One Contact Thermometer, 10°F to 110°F.
12. One Paint Thermometer, 10°F to 110°F.
13. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
14. Two Wet-Film Thickness Gages, Prong Type, capable of measuring 1 to 10 mils in 1 mil increments.
15. Psychrometer and US Weather Bureau Psychrometric Tables.
16. Profile micrometer with extra coarse replica tape.

All equipment will be returned to the Contractor upon completion of the work.

**574-3 CONSTRUCTION DETAILS.** Overcoating is defined as treating corroded areas by spot cleaning and applying two coats of primer, followed by applying intermediate and topcoats of paint to all prepared steel surfaces, both cleaned and primed previously corroded areas and cleaned existing intact painted surfaces. Localized cleaning and painting is defined by spot cleaning and applying four coats of paint, including two coats of primer, intermediate and topcoat, to spot-cleaned steel only.

The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work done while the Engineer has been denied, or restricted from access, shall be recleaned and repainted at no additional cost to the State.

**574-3.01 Quality Control Plan.** The Contractor shall provide the Engineer a copy of the Contractor's Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor's QC personnel to ensure compliance. The QCP shall minimally include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor's QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry-Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification

The Contractor must provide daily reports to the Engineer upon request. The reports shall be submitted no later than 24 hours following the completion of the days work.

**574-3.02 Surface Preparation for Overcoating.** Steel surfaces shall be prepared for painting by a combination of pressure washing and power-tool or vacuum-shrouded blast cleaning. Pressure washing of all areas to be painted shall be performed first, followed by power-tool cleaning of areas demonstrating corrosion of the steel substrate to remove all paint, rust, rust scale, and mill scale, as per SSPC SP-11, *Power Tool Cleaning to Bare Metal* or *SSPC SP-10, Near-White Metal Blast Cleaning* as applicable. If heavy deposits of rust and scale are present, they shall be removed by hand or power tool prior to pressure washing. Areas of tightly adhered coating to remain shall be abraded to provide an anchor profile for overcoat paint. Large deposits of bird droppings shall be removed prior to pressure washing.

**A. Pressure Washing and Solvent Cleaning.** All steel surfaces to be painted shall be pressure washed, using an operating pressure range of 1800 to 2000 psi, a minimum flow of 3.5 gal/minute, and a water temperature of 185°F to 200°F. The nozzle shall be held at a distance of 6 to 12 inches from the steel surface. Pressure washing shall only be allowed when ambient air temperatures are greater than 40°F and rising. In no case will pressure washing be conducted when spent wastewater could freeze on roadway or bridge surfaces or in any other way create a hazardous situation. The washing is intended to remove contaminants from the surface, not to remove tightly adhered paint. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1, *Solvent Cleaning*. The areas shall be pressure washed again following this cleaning.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil, grease, animal waste, salts, and other debris

A containment shall be suspended around and beneath the work area during pressure washing. The containment for pressure washing is intended to capture solid paint chips and other solid debris that may become dislodged from washing operations. Unless otherwise noted, spent wash water will not require collection and will be allowed to fall to the underlying ground or waterway, provided that the other requirements of this specification are met.

Special note, Structural Painting Details, will provide scheduling requirements for washing a structure over a body of water. Spent wash water over a public water supply or the New York City watershed shall be collected and diverted to the adjoining land mass.

If steel surfaces become contaminated or 7 calendar days elapse between washing and abrasive blasting cleaning, they shall be rewashed at no additional cost to the State.

**B. Power Tool Cleaning.** Power tools as described in SSPC-SP 11 shall be used to clean corroded steel. Vacuum-shrouded abrasive blasting may be allowed. Steel cleaned using vacuum-shrouded blasters shall be cleaned to SSPC-SP 10.

**1. Atmospheric Conditions.** No cleaning operations will be conducted under the following conditions:

The relative humidity exceeds 85%.

When the substrate is damp or covered by frost.

The surface temperature is less than 5°F above the dew point.

**2. Steel Cleanliness and Profile.** Surfaces which have become visibly corroded shall be cleaned in accordance with SSPC-SP 11 or SSPC-SP 10, as applicable. Areas where the existing paint has peeled, flaked, blistered, or otherwise become deteriorated shall be cleaned until only sound paint, tightly adherent paint remains. These areas need not be cleaned to SP-11 or SP-10 if the damage does not extend to the steel surface and corrosion of the steel substrate or the mill scale is not evident.

Equipment used shall produce an anchor profile meeting the manufacturer's requirements as reported on the manufacturer's data sheets. The anchor profile shall be measured in accordance with ASTM D4417, Method C.



Special attention shall be given to the edges of beam flanges, angles and plates, bearings, rivets, the heads of nuts and bolts, structural steel surrounding bridge joints, and similar surfaces that are marginally accessible and difficult to clean.

The edges of intact paint shall be feathered back and the adjoining paint must be tightly adhered. Ragged or lifting edges on adjoining paint will not be allowed. Adherence will only be considered satisfactory if the adjoining paint is smoothly feathered back, and cannot be removed by lifting with a dull putty knife.

**3. *Vacuuming.*** The vacuum assembly on all tools shall be capable of containing all visible dust and debris produced by the operation of the cleaning equipment. Air passing through the vacuum assembly shall be exhausted through a HEPA filter. A HEPA filter shall be defined as a filter that is at least 99.97% efficient for particles that are 0.3 µm in diameter, or larger.

**4. *Preparation of Remaining Coating.*** Areas exhibiting damaged or deteriorated paint not extending to the steel shall be power-tool cleaned to remove all damaged or loosely adhered paint and provide a suitable surface for top coating. Loosely adhered paint will lift when scraped with a dull putty knife.

After cleaning and feathering edges, all remaining tightly adhered coating shall be abraded. The abrading operation shall not fracture or remove a significant amount of existing coating, only provide surface profile suitable to receive additional coats of paint. The degree of abrasion shall be in accordance with the manufacturer's recommendations.

The Contractor shall choose the method of abrasion. No additional payment will be made for the appropriate containment and waste collection required to abrade the surface. Open abrasive blasting to abrade the surface shall require a Class A containment, in accordance with Section 570 *Paint Removal Operations*. All other methods of abrasion shall minimally require the same level of containment as specified in contract documents for a particular structure.

If the Contractor chooses a wet-abrasive method for abrasion, the containment must meet the requirements of SSPC – Guide 6, Class 2W. All water and abrasive must be collected and disposed of as hazardous waste.

All dust, powder, or residual abrasive remaining on the surface after the abrading operation shall be thoroughly removed and the remaining surface clean prior to painting.

**5. *Cleaning Area.*** The area cleaned shall be limited to that which can be cleaned, inspected and prime coated within a 10 hour period. Cleaned areas shall be inspected by the Engineer prior to priming. Areas that exhibit flash rusting within the 10-hour period or fail to meet the project cleaning standard prior to painting shall be recleaned.

**C. *Visual and Project Standards.*** The Contractor shall prepare at least one project cleaning standard for each representative area on the structure that is being prepared for painting. Multiple standards may be required if the cleaned steel differs significantly from the photographic standards due to surface conditions, location from work area, or other factors such as distance of the standard from the work area.

The prepared standard shall generally conform to SSPC VIS 3, *Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning* or SSPC VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*, as appropriate, and shall be approved by the Engineer before the start of general cleaning work. Each cleaning standard shall be at least 12 x 12 inches in size, and shall be located in an area of the structure that is accessible to, and approved by the Engineer. The Contractor shall protect the cleaning standard from corrosion and contamination throughout the duration of work by applying a clear coat of polyurethane. At the completion of cleaning work, the project standard shall be recleaned and painted. If the project cleaning standard becomes deteriorated, or otherwise ineffective, it shall be reestablished at no

additional cost to the State. Corroded and deteriorated surfaces that have been cleaned using power tools shall be accepted by visual comparison to the project prepared standard(s) for each structure. In case of a dispute over the visual standard, the written standard shall take precedence.

**574-3.03 Surface Preparation for Localized Cleaning and Painting.** All of the requirements of §574-3.02 shall apply with the exception of abrading the remaining coating. Only tightly adherent existing coating within 6 inches of a power tool cleaned surface shall be abraded.

**574-3.04 Overcoat Painting.** The paint shall appear on the Department's Approved List, 'Structural Steel Paints - Class 2' and be approved for overcoating application.

The Contractor shall apply each coat of paint in the order listed on the Department's Approved List 'Structural Steel Paints - Class 2.'

**A. Atmospheric Conditions.** Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer's data sheets is more restrictive, the manufacturer's range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is absolutely dry. Paint shall not be applied when the relative humidity is more than 85% or the surface temperature is less than 5°F above the dew point. If the manufacturer's requirements are more restrictive they shall be followed. No paint shall be applied during rain.

The Contractor shall observe the dew point restrictions listed on the manufacturer's data sheets.

If an epoxy coating is exposed to cold temperatures or humid conditions outside of the manufacturer's recommended values prior to cure, the surface shall be visually examined for greased or oily surfaces which may have formed. The Engineer may also require the Contractor to use a commercially available amine blush test kit in various locations. If testing indicates the presence of an amine blush or if there is any oily film on the surface, the surfaces shall be cleaned in accordance with paint manufacturer's recommendations at no additional cost to the State.

**B. Paint Mixing.** All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing the bottom of the container shall have no unmixed pigment.

**C. Solvents and Thinners.** Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer, if classified as zinc-rich, shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205 for Zinc-Rich Primers. All other coats of paint shall not be thinned where the resulting VOC level exceeds the maximum allowable Part 205 limit for Industrial Maintenance Coatings. The manufacturer's data sheets shall advise the Contractor and Engineer of the maximum amount of thinner allowed.

Use of unauthorized thinners or using excess amounts of thinners is prohibited. Any area where unauthorized solvents or thinners are used shall be recleaned and repainted at no additional cost to the State. All thinning shall be performed in the presence of the Engineer.

**D. Paint Application.** Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray, brush, or roller, unless otherwise indicated by the contract documents or prohibited by the paint manufacturer. All paint shall be applied so as to produce a uniform, even coating, free of runs, sags, drips, ridges or other defects. Roller nap shall be limited in accordance with the paint manufacturer's recommendation. Areas exhibiting trapped fiber or bristles shall be rejected. Prepared areas that exhibited damaged paint not extending to the steel substrate shall receive two coats of paint : intermediate and finish coat.

Complete protection against paint spatter, spillage, wind-blown paint, or similar releases of paint shall be provided. Covers, tarps, mesh, and similar materials shall be placed around the work area to protect public and private property, pedestrian, vehicular, marine, or other traffic, all portions of the bridge, highway appurtenances, waterways, and similar surrounding areas and property, upon, beneath, or adjacent to the structure. The use of spray equipment for paint application shall be allowed within containments provided that the aforementioned protection against paint release is provided, all equipment used (including tarps, mesh and similar materials) meets all safety requirements for such enclosed use with paint spraying, and all OSHA requirements for safety and ventilation are met.

**E. Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness (DFT) as directed by the range listed on the paint manufacturer's data sheets. The dry-film thickness shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - *Measurement of Dry Film Thickness with Magnetic Gages*, using a Type 2, fixed-probe magnetic gages. Dry film thickness gauges shall be calibrated over a cleaned, approved surface on the structure using two NIST traceable shims as described in the "two point calibration adjustment" section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable.

DFTs of the all coats applied subsequent to the primer shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT readings. An average DFT value shall minimally be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.

Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry film thickness required. The top coating must be performed within the paint manufacturer's specified recoat window.

The Engineer may require any area exceeding the manufacturers recommended dry film thickness to be cleaned to the SSPC-SP 11 or SSPC-SP 10 condition.

**F. Painting Schedule.** Primer shall be applied as per §574-3.02, B.5 of this specification. The second coat of primer shall be applied within 72 hours of the application of the initial prime coat.

The intermediate coat shall be applied within 72 hours of prime coating of the areas as defined by §574-3.02, B.5. All areas of adherent existing paint to be overcoated shall receive the intermediate coat within 72 hours of that area's cleaning operation.

To prevent intercoat adhesion failure, top coat must be applied within the manufacturer's recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to recoat within the specified time period, the surface to be painted shall be cleaned and abraded in accordance with manufacturer's recommendations. This work shall be done at no additional cost to the State.

If the steel has become dirty between coats, the Contractor shall wash the bridge again at no additional cost to the State.

**574-3.05 Painting for Localized Cleaning and Painting.** The paint shall appear on the Department's Structural Steel Paints – Class 1 Approved List, or Structural Steel Paints – Class 2 Approved List and be approved for localized application.

The Contractor shall apply each coat of paint in the order listed on the Department's Approved List.

All of the requirements of §574-3.04 shall apply with the exception of area painted. Only areas that have been cleaned shall be painted. Paint shall not extend more than 6 inches beyond all power-cleaned areas.

#### **574-4 METHOD OF MEASUREMENT**

**574-4.01 Overcoating - Lump Sum.** The work under this item will be measured on a lump sum basis, per structure.

**574-4.02 Overcoating - Square Feet.** The measurement of this item will include the area requiring overcoating, measured to the nearest whole square feet.

**574-4.03 Localized - Square Feet.** The quantity to be measured will be in square feet of area of steel cleaned and painted, measured the nearest whole square feet.

**574-5 BASIS OF PAYMENT**

The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including the cost of providing protection against damage to public and private property during pressure washing and paint application. Payment for the containment, collection and disposal of dust and paint waste generated by surface preparation work shall be paid for separately.

Progress payments will be based on the percentage of steel cleaned and painted. 60% of the quantity will be paid for surface preparation and priming. The remaining amount will be paid following the satisfactory completion of work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
574.01nnnn	Structural Steel Painting: Overcoating	Lump Sum
574.02nnnn	Structural Steel Painting: Overcoating	Square Foot
574.03nnnn	Structural Steel Painting: Localized	Square Foot

NOTE: nnnn denotes a serialized pay item.

**SECTION 575 (VACANT)**

**SECTION 576 - BRIDGE DRAINAGE SYSTEM**

**576-1 DESCRIPTION.** This work shall consist of furnishing and placing scuppers, drainage troughs and downspout systems for bridge drainage as shown on the plans and in accordance with the specifications.

**576-2 MATERIALS**

Cast Iron Scuppers	ASTM A48M, Class 30 and 715-05
Fabricated Steel Scuppers (Except Gratings)	
Plates or Bars	ASTM A36 and 715-01 <sup>1</sup>
Tubes	ASTM A500, Grade B <sup>1</sup>
Headed Concrete Anchor Studs	ASTM A108, Grade 1015 or 1020
Grating Plates and Bars	ASTM A36, A242, or A572, and 715-01 <sup>1</sup>
Bolts and Cap Screws	ASTM A307 Grade A
Drainage Troughs (PVC)	705-11
Steel For Erection of Trough	
Bars <sup>2</sup> (A1, A2) and Plates <sup>2</sup> (B1, B2, C1 and C2)	ASTM A575, Grades 1015 and 1020
Rods (fully threaded) and Bolts <sup>3</sup>	ASTM A307
Clamps, Malleable Iron	ASTM A47/A47M, Grade 32510 and 715-09
Ductile Iron Downspout Pipe and Pipe Fittings	ASTM A377 (ANSI 21.51) <sup>4</sup>
Pipe Couplings <sup>5</sup> (Ductile Iron or Malleable Iron)	ASTM A536 or A47/A47M Grade 32510

Hoppers <sup>6</sup>	ASTM A36 and 715-01
Pipe Brackets and Supports	ASTM A575, Grade 1015 and 1020
Anchors	GSA FS-S-325 Group I, Type I, Class I
Nuts and Bolts <sup>6</sup>	ASTM A307
PVC Downspout Pipe, Fittings and Solvent Cement	706-15
Protective Cover (Cellular Polystyrene)	706-16

**NOTES:**

1. In addition to the requirements of 715-01, Structural Steel, the Contractor will be required to furnish the Deputy Chief Engineer (Structures), two (2) certified copies of the records of the chemical analysis of the steel.
2. Bars shall be 5/8 inch diameter. Plates shall be 2 x 1/4 inch.
3. Bolts shall be Slotted Button Head Machine Bolts.
4. All pipe shall be groove cut around the full pipe circumference at both ends. The grooves shall be radius cut in accordance with AWWA C606. The grooves shall be such that a keyed housing clamp coupling shall fit into them. The grooves shall be such that a keyed housing clamp coupling shall fit into them. Unless otherwise approved, all pipe bends (elbows) shall be of the long radius type.
5. All couplings shall be gasketed, double keyed, housing clamps designed to lock and seal the joint between two grooved pipes, or fittings, when the housing clamp is bolted and tightened in place. The gasket shall be a molded or extruded compound of Butyl or EDPM, suitable for water service.
6. Galvanized in accordance with the requirements of 719-01. Nuts and bolts shall be galvanized in accordance with 719-01, Type II.

**576-3 CONSTRUCTION DETAILS**

**576-3.01 Fabrication**

**A. Shop Drawings.** Shop drawings will not be required for scuppers, drainage troughs or downspout systems.

**B. Welding**

**1. Fabricated Steel Scuppers, Gratings.** Welding shall conform to the provisions of the SCM. Weld inspection shall be done in accordance with the requirements of the SCM but radiographic testing will not be required. All groove welds shall be complete joint penetration groove welds unless otherwise approved by the DCES.

**2. Drainage Troughs.** Field Welding (by heat) of the polyvinyl chloride trough material shall not be allowed without written permission of the Deputy Chief Engineer (Structures).

**C. Galvanizing**

**1. Scuppers and Troughs.** Galvanizing shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods. Galvanizing shall be done after all welding and fabrication is completed.

**2. Bolts, Fully Threaded Rods and Nuts.** All bolts and rods shall have a ANSI B1.13M Class 6H thread. All galvanized nuts shall have a standard oversize tap to allow for the galvanizing on the bolts, rods and nuts.

**D. Gratings.** Gratings for Types B1 and B2 scuppers shall have a full and even bearing on the underlying surface.

**E. Basis of Acceptance.** Scuppers, drainage troughs and downspouts shall be accepted at the work site by the Engineer-in-Charge upon certification of the manufacturer that the materials used and fabrication procedure employed conform to the requirements of section 576. The Engineer may reject any scupper, drainage trough or downspout system which, in his opinion, exhibits poor quality or workmanship.

## **576-3.02 Erection of Downspout Systems**

### **A. General**

**1. Pipe Installation.** The pipe shall be laid true to line and grade as shown on the plans or as directed by the Engineer, with joints close and even, so that a true and even surface of invert will be made over the joints throughout its entire length. Horizontal pipe shall be installed so that the minimum slope shall not be less than 1:50. Pipe shall be placed in accordance with the requirements of this specification unless special methods are called for on the plans or in the itemized proposal.

**2. Field Testing.** Prior to the acceptance of the structure by the Department, the downspout system should be flushed out and tested to insure that it is flowing at full capacity. Any obstruction in the downspout system preventing the free flow of drainage or its operation at full capacity shall be removed to the complete satisfaction of the Engineer.

### **B. Ductile Iron Downspouts**

**1. Pipe Supports.** Supports for horizontal piping shall be spaced 5 feet maximum. Supports for vertical piping shall be spaced 6 feet maximum.

**2. Pipe Joints.** All joints in pipe, except when encased in concrete, shall be made with groove type couplings. Pipes encased in concrete shall have joints formed in accordance with the pipe manufacturer's recommendations.

**3. Painting.** All metal embedded in concrete shall not be painted. All other metallic portions of the downspout system shall be painted in the field in accordance with the requirements of the contract documents. Color shall be as shown on the plans.

### **C. PVC Downspouts and Protective Insulator**

**1. Pipe Joints.** PVC pipe joints shall be sealed in the following manner: All necessary cuts shall be square and clean from burrs. Mating surfaces of pipe and fittings shall be cleaned with methyl ethyl ketone or acetone prior to solvent cement application. The solvent cement shall be applied as recommended by the manufacturer. The pipe and fitting should be joined with a twisting motion to distribute cement uniformly. The solvent cement manufacturer's recommendations for cure time shall be followed.

**2. Protective Insulator.** The protective insulator shall be attached to the pipe in such a manner so as to prevent its dislodgement as the concrete is placed. Suitable methods would include taping the joints with a weather resistant tape or bonding with a non-metallic substance.

**3. Form Wire.** The PVC pipe and its protective insulator shall be held in place by form wire in such a manner as to provide sufficient lateral support to prevent movement as the concrete is placed.

**4. Vibrator.** Particular caution shall be taken to prevent the vibrator from striking the pipe and its protective insulator during the placing of concrete.

#### **576-4 METHOD OF MEASUREMENT**

**576-4.01 Scuppers.** Payment will be made at the unit price bid for each type of scupper furnished and placed as shown on the plans and in accordance with the specifications.

**576-4.02 Drainage Troughs.** The trough shall be measured as the number of feet measured along the center line of each polyvinyl chloride section, furnished and placed as shown on the plans and in accordance with the specifications.

**576-4.03 Downspout System.** The downspouts will be measured as the number of feet measured along the center line of pipe between the extreme outer limits of downspouts, including hoppers, furnished and placed as shown on the plans and in accordance with the specifications.

#### **576-5 BASIS OF PAYMENT**

**576-5.01 Scuppers.** The unit price bid for each type of scupper shall include the cost of furnishing all labor, equipment and materials necessary to set the scupper to its proper line and grade. No additional payment will be made for furnishing and placing the grating for the Type B1 or B2 scupper.

**576-5.02 Drainage Troughs.** The unit price bid per foot shall include the cost of furnishing all labor, materials and equipment necessary to erect the trough and its threaded rod supports as indicated on the plans.

#### **576-5.03 Downspout System**

**A. General.** The unit price bid per foot shall include the cost of furnishing all labor, materials and equipment necessary to erect the pipe and pipe fittings, pipe supports, hoppers, nuts, bolts, washers, to provide cleanouts if indicated on the plans, straps to cap and plug the pipe if necessary, and to replace cracked or otherwise defective material necessary to complete the work.

**B. Ductile Iron Downspouts.** The unit price bid per foot shall also include the cost of furnishing and placing pipe hangers and brackets, grooved type couplings and paint.

**C. PVC Downspouts and Protective Insulator.** The unit price bid per foot shall also include the cost of furnishing and placing the protective insulator and all adaptor fittings required at the juncture of PVC Pipe and Ductile Iron Pipe.

**D. Excavation.** All required excavation will be paid for under pay item 206.02 Trench and Culvert Excavation and 206.04 Trench and Culvert Excavation - O.G.

#### **Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
576.01	Scuppers (Type A)	Each
576.02	Scuppers (Type B)	Each
576.10	Drainage Trough	Foot
576.2001	Downspout System (Ductile Iron)	Foot
576.21	Downspout System (PVC)	Foot

**SECTION 577 (VACANT)****SECTION 578 - BONDED CONCRETE OVERLAY FOR STRUCTURAL SLABS**

**578-1 DESCRIPTION.** Prepare the surfaces that will be in contact with slab reconstruction concrete and place slab reconstruction concrete. Prepare the structural slab surface and place a Class E, bonded concrete overlay.

**578-1.01 Scope.** Concrete removal work will be paid for under the appropriate item(s). Minimum thickness of the overlay concrete is 3 inches. Include the cost of any grade changes necessitated by this requirement in the unit bid price for overlay concrete.

**578-1.02 Definitions**

**A. Overlay Concrete.** Class E Concrete placed over existing and slab reconstruction concrete.

**B. Slab Reconstruction Concrete.** Concrete placed completely around the exposed top mat of bar reinforcement. Slab reconstruction concrete will be Class D for Method 1 and Class E for Method 2, as described in §578-1.03 Placement Methods.

**578-1.03 Placement Methods.**

**A. Method 1 - Separate Placement.** Place Class D slab reconstruction concrete and Class E overlay concrete separately.

**B. Method 2 - Integral Placement (Optional).** When 100% of the top mat of bar reinforcement is exposed or when all of the following conditions are satisfied, Class E overlay concrete and Class E slab reconstruction concrete may be placed in a single lift.

1. The area of the exposed top mat of bar reinforcement is 5% or less of the placement area, per span.
2. No individual area of the exposed top mat of bar reinforcement exceeds 25 sf.
3. No dimension of any area of the exposed top mat of bar reinforcement exceeds 6 feet.

**578-2 MATERIALS.** All material listed under §557-2.

**578-3 CONSTRUCTION DETAILS .**

**578-3.01 Blast Cleaning.** §584-3.02

**578-3.02 Preplacement Wetting.** §584-3.03

**578-3.03 (Vacant)**

**578-3.04 Handling and Placing Concrete.** §584-3.05

**578-3.05 Construction Joints.** §584-3.07

**578-3.06 Finishing and Curing Slab Reconstruction Concrete - Separate Placement.** §584-3.09



**578-3.07 Finishing Bonded Concrete Overlay.** §557-3.07

**578-3.08 Curing Bonded Concrete Overlay.** §557-3.11 with the following: Cure concrete with wet burlap for 7 days. Provide uniform continuous wetting until concrete curing is complete. The wet burlap and curing cover option is not allowed.

**578-3.09 Opening to Traffic.** Traffic is allowed only after completion of the required curing period.

**578-3.10 Defective or Damaged Concrete.** §584-3.08

**578-4 METHOD OF MEASUREMENT.** For placements with 100% exposure of the top mat of bar reinforcement, the number of square feet of slab reconstruction concrete will be equal to the number of square feet of overlay concrete.

For placements with less than 100% exposure of the top mat of bar reinforcement, measure slab reconstruction concrete prior to overlay concrete placement.

**A. Method 1- Separate Placement.** Measure slab reconstruction concrete as the number of square feet of Class D slab reconstruction concrete placed. Measure overlay concrete as the number of square feet of plan area of Class E overlay concrete placed.

**B. Method 2- Integral Placement (Optional).** Measure slab reconstruction concrete as the number of square feet of Class E slab reconstruction concrete placed. Measure overlay concrete as the number of square feet of plan area of Class E overlay concrete placed.

**578-5 BASIS OF PAYMENT.** Include the cost of all labor, materials and equipment necessary to complete the work in the unit bid price.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
578.1201nn	Overlay Concrete, Class E – Type 1 Friction	Square Foot
578.1202nn	Overlay Concrete, Class E – Type 2 Friction	Square Foot
578.1203nn	Overlay Concrete, Class E – Type 3 Friction	Square Foot
578.1209nn	Overlay Concrete, Class E – Type 9 Friction	Square Foot
578.1300nn	Slab Reconstruction Concrete, Class D or E	Square Foot

NOTE: nn denotes a serialized pay item.

**SECTION 579 - STRUCTURAL SLAB RECONSTRUCTION PREPARATION**

**579-1 DESCRIPTION.** The work shall consist of initially preparing an existing structural slab for reconstruction. Generally, this work shall entail the removal of concrete to the depths, and at the locations, required by the contract documents.

**579-1.01 Structural Slab Scarification**

A. This work shall consist of removing the top surface of structural slab concrete. Removal shall be done by scarification to the following limits, unless a greater depth is indicated on the plans:

- Minimum of 1/4 inch
- Maximum of 1/2 inch

- B. After scarification, if a structural slab survey is required, the surface to be surveyed shall be cleaned sufficiently to allow the survey to be taken. The Engineer will determine if the surface is cleaned sufficiently to allow performance of the necessary delamination and potential survey tests.
- C. All removed materials shall be transported from the work site and disposed of or disposed of in an area on the job site approved by the Engineer.

**579-1.02 Exposure of Reinforcing Bars**

**A. Definitions**

**1. Bar Mat.** That combination of transverse and longitudinal reinforcing steel placed with the structural slab to absorb stresses. Structural slabs generally contain two bar mats; an upper mat and a lower mat.

**2. Upper Mat.** That bar mat closest to the existing top surface of the structural slab. Only the upper mat is relevant to this work, except in localized areas.

**3. Localized Area.** An area where full depth removal and subsequent patching will be done as part of this work. For the work of this section a localized area shall not exceed 25 sf. The sum of the localized areas shall comprise no more than five percent (5%) of the structural slab area to be prepared.

**B.** The work shall consist of structural concrete removal from the periphery of the upper mat reinforcing bars to provide a minimum clearance of 1 inch between the reinforcing bar surface and the remaining concrete surface. In addition, the Engineer may order the removal of other concrete. (Refer to 579-3, Construction Details).

**C.** All work performed under the requirements of this subsection shall not extend beyond a plane which is 5 inches below the original top of slab, except for localized areas.

**D.** Removed materials shall be disposed of in accordance with 579-1.01B.

**579-2 MATERIALS**

Class A Concrete <sup>1</sup>	501 <sup>2</sup>
Quilted Covers (for curing concrete)	711-02
Plastic-Coated Fiber Blankets (for curing)	711-03

**NOTES:**

- 1. 501, Class D Concrete, may be substituted at no extra cost.
- 2. For quantities of 5 cy of total project placement, or less, automatic batching equipment will not be required.

**579-2.01 Equipment**

**A. Power Operated Scarifier.** The specific equipment the Contractor proposes to use shall be approved by the Engineer prior to use. Power bush hammers, or other impact type devices which indent or pulverize the surface shall not be allowed under any circumstances.

**B. Pneumatic Hammers and other equipment.** These shall be subject to the Engineer's approval prior to use. Pneumatic hammers shall meet the requirements of §580-3.02

**C. Other Equipment.** All other equipment proposed for use shall be approved by the Engineer prior to actual employment in the work.

**579-3 CONSTRUCTION DETAILS.** The Contractor shall exercise care during the execution of the work to avoid damaging or loosening material that is to remain. All damage caused by the Contractor's operations to material that is to remain shall be repaired, or the material replaced as determined by the Engineer. All repair and replacement work shall be done in a manner satisfactory to the Engineer.

**579-3.01 Structural Slab Scarification.** Scarification of designated areas shall be accomplished with a power operated scarifier. Inaccessible areas will be scarified with pneumatic hammers.

#### **579-3.02 Reinforcing Bar Exposure**

A. Concrete shall be removed from the uppermost reinforcing bars of the structural slab to the limits designated by §579-1.02B. The Contractor may remove concrete, to the designated minimums, from around both sets of bars in the upper mat.

B. If concrete is removed only from the periphery of the uppermost bar, removal shall be done in accordance with those details indicated on the plans.

C. If the Contractor chooses to remove concrete from the periphery of both bars of the upper mat, or if the Engineer determines that:

- The lower bar is corroded; OR
- The concrete around the lower bar is deteriorated; OR
- Delamination extends to the level of, or below, the lower bar; OR
- The lower bar is debonded;

then the concrete shall be removed from the periphery of the lower bar in accordance with the details indicated on the plans.

D. At locations where deteriorated concrete extends beyond the minimum removal limits, the Engineer will order its removal. The Engineer will be the sole determiner of what constitutes deteriorated concrete. This ordered removal shall be part of this work, except that removal of deteriorated concrete below the limit established by §579-1.02C, shall be part of this work only within the limits of localized areas.

Locations where concrete is removed beyond minimum limits, lacking specific orders from the Engineer directing such removal, will be designated as damage locations. All damage locations shall be repaired in a manner satisfactory to the Engineer, at no additional cost to the State.

E. At localized areas, the Engineer may order concrete removal below the plane established by §579-1.02C. When such removal reaches the uppermost bar of the lower reinforcing bar mat, removal shall be continued until full depth removal is achieved.

F. Care shall be exercised when removing concrete to avoid damaging reinforcement, or other materials, which are to remain in place. Reinforcing steel damaged by the Contractor's operations shall be replaced with new reinforcing steel of the same size, appropriately spliced. Reinforcing steel splices shall be made in accordance with the details shown on the plans. Other materials designated to remain in place, which are damaged by the Contractor's operations, shall also be replaced.

**579-3.03 Full Depth Patches.** Refer to the details indicated on the plans.

A. Immediately prior to placing new concrete, the reinforcing bars and the edges of the existing structural slab, which will be in contact with new concrete, shall be blast cleaned. Forms shall be drawn tightly. Preparation and formwork shall be approved by the Engineer prior to any concrete placement. "After blast cleaning has been accepted, thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing

water with oil-free compressed air, and protect the surface from drying, so the concrete remains in a saturated surface dry condition when placing bonding grout.

B. Concrete shall be placed and consolidated in accordance with the requirements of §555-3.04. The uppermost surface of the concrete patch shall be level with the highest of the surrounding prepared surfaces. The uppermost surface shall be intentionally roughened. The Engineer may require that a coarse textured drag be used on the plastic concrete surface.

C. Concrete shall be cured, in a manner approved by the Engineer, for a minimum of 72 curing hours prior to any other concrete placement work in contact with the curing concrete. A curing hour is defined as any hour, starting from the hour of placement, during which the ambient air temperature at the concrete surface remains at, or above 45°F as measured by a recording thermometer. Curing shall be done by means of quilted covers (§711-02), or plastic coated fiber blankets (§711-03). Quilted covers, if used, shall be kept wet during the entire curing period. The use of curing compounds shall not be allowed.

**579-3.04 Hydrodemolition Equipment.** Hydrodemolition equipment, if approved by the Engineer, shall be subject to the following:

**A. Water Filtration and Disposal.** At least two weeks prior to the employment of any hydrodemolition equipment, the Contractor shall submit to the Engineer, for approval, a comprehensive plan for the filtration and disposal of hydrodemolition water.

The Contractor is specifically notified that use of the existing bridge drainage system for hydrodemolition water disposal will not be permitted.

**B. Water Retention.** Hydrodemolition water shall be prevented from running onto, or over all portions of the project site not immediately subject to hydrodemolition work. In addition, the Contractor shall provide shielding, acceptable to the Engineer, that protects traffic and prevents all debris from escaping the immediate work location. A comprehensive plan for accomplishing these requirements shall be submitted to the Engineer, for approval, at least two weeks prior to the beginning of any hydrodemolition work.

The Contractor is specifically notified that use of the existing bridge drainage system, for this purpose, will not be permitted.

The plan for this work may be submitted as part of the requirements of §579-3.04A.

**C. Adherence.** Once approved, the water filtration and disposal, as well as the water retention plans shall be strictly adhered to by the Contractor. Should the Engineer determine that these plans are not being followed as approved, the Contractor will be required to immediately cease work until the conditions are rectified in a manner satisfactory to the Engineer.

Should the Contractor fail to rectify the situations to the Engineer's satisfaction, the Engineer may, with the concurrence of the D.C.E.C., require the Contractor to use equipment other than hydrodemolition equipment.

No extension of time will be granted, nor will any additional compensation be granted, for either the ceasing of work, or the substitution of equipment, if either one is required as a result of the Contractor's failure to follow the approved plans.

**D. Debris Removal.** All debris shall be removed quickly enough to prevent rebonding of the debris to the concrete surface. All debris which rebonds shall be removed in a manner satisfactory to the Engineer at no cost to the State.

Material designated to be left in place, which is damaged by rebonded debris removal work, shall be repaired in a manner satisfactory to the Engineer at no cost to the State.

## 579-4 METHOD OF MEASUREMENT

**579-4.01 Structural Slab Scarification.** The work will be measured as the number of square feet stated in the Estimate of Quantities shown on the plans. Except to allow for progress payments, no field measurements will be taken. Field measurements for progress payments shall not exceed the Estimate of Quantities figure.

**579-4.02 Reinforcing Bar Exposure.** The work will be measured as the number of square feet of concrete removed. Quantities will be determined from field measurements.

**579-5 BASIS OF PAYMENT.** The unit price bid per square foot shall include the cost of all labor, materials and equipment necessary to complete the work. No additional payment will be made for removals, repairs or replacements made necessary due to the Contractor's operations.

**579-5.01 Reinforcing Bar Exposure.** The unit price bid per square foot shall include the cost of all labor, material and equipment necessary to perform full depth patching in localized areas. Full depth concrete removal, and full depth patching, in excess of the limits established for localized areas will be paid for as extra work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
579.01	Structural Slab Scarification	Square Foot
579.02	Reinforcing Bar Exposure	Square Foot

## **SECTION 580 - REMOVAL OF STRUCTURAL CONCRETE**

(Last Revised September, 2016)

**580-1 DESCRIPTION.** This work shall consist of removal and disposal of structural concrete from structural concrete elements, concrete approach slabs, concrete bridge pylons, concrete from structural steel members, and other concrete removal and disposal in accordance with the contract documents and as directed by the Engineer.

**580-2 MATERIALS.** Not Specified.

### **580-3 CONSTRUCTION DETAILS**

**580-3.01 General.** The Contractor shall remove structural concrete in accordance with the contract documents, so as not to damage material designated to remain in place. Reinforcement designated to remain in place shall be cleaned.

The Contractor shall only remove structural concrete from elements to remain to the limits shown in the contract documents, in order to preserve structural adequacy and stability. Replacement concrete shall be placed and allowed to reach its initial set prior to any additional removals. A minimum of 7 calendar days prior to beginning removal of structural concrete, the Contractor shall provide a Structural Concrete Removal Plan for acceptance by the Engineer. The Structural Concrete Removal Plan shall identify the equipment to be used, the sequence of operations, provisions for protection of structural steel, provisions for removal and disposal of material, and any additional work zone traffic control or worker safety provisions.

**580-3.02 Removal of Structural Concrete.** The Contractor shall remove concrete to a sound surface in accordance with the contract documents. The removal operation shall be angled inward creating a key. Small angle corners shall be minimized per contract documents to prevent voids. Reinforcing bars and miscellaneous material shall be removed or shall be retained, as shown in the contract documents. After

removal of concrete has been performed, surfaces designated to come in contact with new concrete placements shall be cleaned in order to ensure proper bonding with the new concrete. Concrete surfaces to be cleaned shall be thoroughly blast cleaned or abraded by other mechanical means to remove remaining loose material. After blast cleaning or abrading, vertical or overhead surfaces shall be air-blown, or rinsed with water to remove dust. Other surfaces shall be vacuum cleaned.

Demolition or chipping hammers shall weigh no more than 45 lbs excluding the weight of the bit and muffler. The hammers shall deliver no more than 1600 blows per minute. The Contractor shall provide the Engineer information from the hammer manufacturer to assure that these requirements are not exceeded. The air pressure used to power the hammer shall not exceed 110 psi, measured at the air compressor, as shown by an air pressure gauge in proper working condition provided by the Contractor. Only sharp chisel point bits, a minimum of 2 inches wide, shall be used.

If the Contractor's operations result in damage to concrete that is to remain, the Contractor shall make immediate corrections to prevent damage. Exceptions to the hammer limitations shall be approved by the Deputy Chief Engineer (Structures) prior to use.

**580-3.03 Removal of Concrete Approach Slabs.** The Contractor shall remove concrete approach slabs in accordance with the contract documents. Sawcutting of the concrete approach slab in order to separate it from existing abutment will be shown in the contract documents and paid for separately.

#### **580-4 METHOD OF MEASUREMENT**

**580-4.01 General.** Vacant.

**580-4.02 Removal of Structural Concrete.** The quantity to be measured for payment will be in cubic yards measured to the nearest 0.1 cubic yards of concrete removed.

**580-4.03 Removal of Concrete Approach Slabs.** The quantity to be measured for payment will be in square feet of concrete approach slab removed, measured to the nearest whole square foot.

#### **580-5 BASIS OF PAYMENT**

**580-5.01 General.** Vacant.

**580-5.02 Removal of Structural Concrete.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, and all costs of disposal.

**580-5.03 Removal of Concrete Approach Slabs.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting other than separating the approach slab from the existing abutment, and all costs of disposal.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
580.01	Removal of Structural Concrete	Cubic Yard
580.04	Removal of Concrete Approach Slab	Square Foot

### **SECTION 581 - REMOVAL OF BRIDGE OVERLAYS**

**581-1 DESCRIPTION.** The work shall consist of the removal and disposal of bridge overlays, reinforcement, if present, and any miscellaneous materials encountered, as shown on the contract plans.

**581-2 MATERIALS.** Not specified.

**581-3 CONSTRUCTION DETAILS.** Not specified.

**581-4 METHOD OF MEASUREMENT.** The work shall be measured by the area of bridge overlay, removed and disposed of. The quantities will be determined from field measurements.

**581-5 BASIS OF PAYMENT.** The unit price bid per square foot shall include the cost of furnishing all labor and equipment to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
581.01	Removal of Bituminous Concrete Overlay (Bridge)	Square Foot
581.02	Removal of Cement Concrete Overlay (Bridge)	Square Foot

**SECTION 582 - REMOVAL AND REPLACEMENT OF STRUCTURAL CONCRETE**  
(Last Revised January, 2021)

**582-1 DESCRIPTION.** The work shall consist of the removal and disposal of unsound structural concrete from an existing structure and its replacement with new structural concrete, or an approved patching material, as indicated on the contract plans, or as ordered by the Engineer. All work shall be done at the locations indicated on the contract plans, or where ordered by the Engineer.

All miscellaneous materials, not including bar reinforcement, encountered during the removal of unsound structural concrete, shall be removed and disposed of unless otherwise indicated on the contract plans, or ordered by the Engineer.

**582-2 MATERIALS.** Materials used in this work shall conform to the following requirements:

Vertical and Overhead Patching Material	701-08
Water	712-01
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Membrane Curing Compound	711-05
Admixtures	711-08

**582-2.01 Replacement Concrete.** Concrete shall be Class A or Class D concrete for structures. It shall conform to the requirements of Section 501 - Portland Cement Concrete - General.

**582-2.02 Vertical and Overhead Patching Material.** The patching material used shall be a brand that appears on the Department's Approved List.

**582-3 CONSTRUCTION DETAILS**

**582-3.01 Repair Determinations.** The choice of replacement material will be indicated on the plans, determined by the Engineer, or determined by the contractor. The Contractor's determinations shall be made in accordance with the criteria of this subsection, and only in the absence of directions from the plans, or the Engineer. The Contractor's determinations shall be approved by the Engineer prior to the actual performance of the work.

*A. Horizontal or Essentially Horizontal Locations.* Class A, Class D or Class DP concrete shall be used. Class A concrete shall be placed only at locations where removal depths average greater than 5 inches. Class D concrete shall be placed only at locations where removal depths average between 1 ½

and 5 inches. Class D or DP may be used for pedestal repairs when access is limited and where placement dimensions are greater than 1½ inches but do not exceed 12 inches. Average depth shall be determined by a measurement procedure acceptable to the Engineer.

**B. Vertical or Essentially Vertical Locations.** Class A concrete, Class D concrete, or approved patching material shall be used. Concrete classes shall be restricted to the depth limitations noted for horizontal locations. Patching material shall be placed at locations where removal depths average between 1/2 and 1 1/2 inches. Average depths shall be determined by a measurement procedure acceptable to the Engineer.

**C. Overhead.** Class A, Class D or approved patching material shall be used when formwork is provided. Concrete classes shall be restricted to the depth limitations noted for horizontal locations. Approved patching material may be used without formwork provided lift thicknesses do not exceed 1 inch. Anchoring devices shall be used when patching material is used for repair depths of 1½ inches or greater.

**D. Pockets.** Locations, within locations of 1 1/2 inches in average depth or less, which exceed this average depth, shall be filled with Class A, or Class D, concrete in accordance with the limitations outlined under horizontal locations.

**582-3.02 Removal of Unsound Concrete.** All unsound concrete shall be removed to a sound surface as determined by the Engineer. If called for on the plans, the existing concrete shall be saw-cut to obtain a straight joint between the existing concrete and the new material. Care shall be exercised while removing the unsound concrete so as not to damage materials which are to remain in place. Exposed reinforcement remaining in place shall be cleaned in accordance with the requirements of §584-3.02A. Chipping hammers shall meet the requirements of §580-3.02.

**A. Removal for Concrete Replacement.** The minimum depth of removal shall be the greater of the following:

- A depth no less than 1 1/2 inches from the rear most point of reinforcement to sound concrete.
- The depth necessary to reach sound concrete.

Should the removal depth exceed 6 inches, the Engineer may order supplementary anchoring as part of the replacement procedure. The sides of the cavity shall be made at a slight angle, so that the width of the base of the cavity is greater than the opening at the surface, thereby providing a key.

**B. Removal for Patching material Replacement.** Feather edges shall not be permitted. The minimum patch depth shall be 1/2 inch as measured from the theoretical plane of the original concrete surface.

### **582-3.03 Preparation of Surface**

A. All surfaces receiving new material shall be blast cleaned in accordance with the requirements of §584-3.02.

B. Bar reinforcement shall be placed at the location indicated on the plans, and at all additional locations determined by the Engineer.

C. Existing reinforcement, which, in the Engineer's opinion, has lost significant section, shall be repaired in a manner satisfactory to the Engineer.

D. Bar placement, and bar repair work directed by the Engineer will be paid for separately.



**582-3.04 Placement.** Air clean the surface with oil-free compressed air. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. This may be accomplished by continuous wetting with soaker hoses or the use of burlap/burlene/etc. where moisture can be maintained. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Surfaces must be wetted by a means acceptable to the Engineer using potable water.

The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete. No material shall be placed if the ambient air, or concrete surface temperature is at, or below 45°F.

**A. Concrete Placement.** All concrete placements shall be in accordance with the applicable requirements of the following subsections:

555-3.02, 555-3.03A, 555-3.04, 555-3.06, 555-3.07, 555-3.08.

If formwork configuration, or clearances between formwork, steel and existing concrete are such that Class A, or D, concrete cannot be placed without voids, or honeycombing, the Contractor may, with the Engineer's permission, use an approved high range water reducer to increase the concrete's workability. Approved high range water reducers appear on the Department's Approved List.

The high range water reducer shall be added at the work site only and shall be dispersed uniformly throughout the plastic concrete. The Engineer shall approve the Contractor's dispersal methods and devices prior to their actual use.

The high range water reducer shall be added only after the concrete has reached the proper slump and contains the required quantity of air. No more than two additions of the admixture shall be made, and the manufacturer's maximum dosage rate shall not be exceeded. After the admixture has been added, the concrete shall be mixed an additional 30 revolutions. The second admixture addition shall be made only after the 30 revolutions required for the first addition have been completed. It is the responsibility of the Contractor to ensure that concrete slump does not exceed 9 inches, and air content remains within specification requirements. Plastic concrete mixes failing to meet the foregoing requirements will be subject to rejection. Replacement will be done at the Contractor's expense.

The Engineer may allow high range water reducer to be added at the concrete batching facilities. Consideration for this procedure will be undertaken only after the Contractor has clearly demonstrated the capability of providing concrete which meets the requirements of this subsection.

**B. Vertical and Overhead Patching Material Placement.** Patching material shall be prepared in accordance with the directions provided by the manufacturer. The Engineer shall be given two copies of the manufacturer's printed instruction at least two weeks prior to the start of all patching work. This shall include the mixing proportions and the mixing method. The manufacturer's literature shall be consulted for surface preparation and priming instructions. The material shall be troweled on in layers, the thickness of which depends on the material consistency and the location and profile of the surface to which it is applied. However, lift thickness in excess of 1 inch will not be permitted without the use of anchoring devices or formwork at overhead locations. Special curing procedures are generally not required, except under conditions of high heat, low humidity, or strong winds, as defined by the manufacturer. The manufacturer should be consulted for specific curing procedures under these adverse conditions.

**582-3.05 Form Removal.** Form removal shall be in accordance with §555-3.09 with the following exception:

Forms shall be removed from thin concrete placements 24 curing hours after placement has been completed unless the Engineer determines the concrete is not strong enough to withstand damage. For

purposes of this subsection, a thin concrete placement begins at the outermost surface of the new concrete and generally terminates at, or before, the midpoint of the main reinforcing steel. Concrete may be removed and replaced completely around one or two main reinforcing steel members to a depth no greater than 1 inch from the innermost surface of those members and still be considered a thin concrete placement. Main reinforcing steel members include reinforcing bars, but not spiral reinforcement or stirrups. Curing procedures shall be implemented immediately upon form removal.

**582-3.06 Curing.** Curing shall be performed according to the following:

*A. Concrete.* This shall be done in accordance with §555-3.08.

*B. Vertical and Overhead Patching Material Curing.* Manufacturer's recommendations for curing shall be followed for the patching material applications.

#### **582-4 METHOD OF MEASUREMENT**

**582-4.01 Removal of Structural Concrete - Replacement with Class A Concrete.** Measurement shall be made as the number of cubic yards of concrete placed where indicated on the contract plans, or where ordered or approved by the Engineer.

**582-4.02 Removal of Structural Concrete - Replacement with Class D Concrete.** Measurement will be made as the number of square feet repaired as indicated on the contract plans, or where ordered or approved by the Engineer. No reductions in area will be made around corners.

**582-4.03 Removal of Structural Concrete - Replacement with Vertical and Overhead Patching Material.** Measurement shall be made as the number of square feet of the plane projection of the repaired area as indicated on the contract plans, or where ordered or approved by the Engineer. Measurement shall be made prior to the placement of patching material.

#### **582-5 BASIS OF PAYMENT**

**582-5.01 Removal of Structural Concrete - Replacement with Class A Concrete.** The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that bar reinforcement removal and replacement shall be paid for separately. Progress payments will be made in accordance with §582-5.04.

**582-5.02 Removal of Structural Concrete - Replacement with Class D Concrete.** The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that bar reinforcement removal and replacement shall be paid for separately. Progress payments will be made in accordance with §582-5.04.

**582-5.03 Removal of Structural Concrete - Replacement with Vertical and Overhead Patching Material.** The unit price bid per square foot shall include all labor, materials and equipment necessary to complete the work. Progress payments will be made in accordance with §582-5.04.

**582-5.04 Progress Payments.** Progress payments will be made when the concrete removal is completed. Payment will be made at the unit price bid for 50% of the quantity removed. The balance of the quantity will be paid upon completion of the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
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582.05	Removal of Structural Concrete - Replacement with Class A Concrete	Cubic Yard
582.06	Removal of Structural Concrete -Replacement with Class D Concrete	Square Foot
582.07	Removal of Structural Concrete -Replacement with Vertical and Overhead Patching Material	Square Foot

## SECTION 583 - SHOTCRETE

### 583-1 DESCRIPTION

**583-1.01 Work.** The work shall consist of removal and disposal of unsound structural concrete and replacement with shotcrete where indicated in the contract documents and where ordered by the Engineer. The Contractor has the option of using either the Dry Mix Process or the Wet Mix Process.

#### 583-1.02 Definitions

**A. Shotcrete.** This is mortar conveyed through a hose and pneumatically projected at high velocity onto a surface.

**B. Dry Mix Process.** This is a process in which the dry cement-sand mixture is carried by compressed air to the nozzle where water is injected and the resulting mixture is jetted from the nozzle at high velocity onto the surface to be shotcreted.

**C. Wet Mix Process.** This is a process in which all the ingredients including water are thoroughly mixed and then jetted from the nozzle at high velocity onto the surface to be shotcreted.

**D. Delivery System.** This consists of the nozzle, water ring or air ring, and any necessary valves, connected to the delivery hose.

**583-2 MATERIALS.** Materials used in this work shall conform to the following requirements:

Portland Cement, Types 1 or 2	701-01	Quilted Covers (for curing)	711-02
Concrete Sand	703-07	Plastic Coated Fiber Blankets	711-03
Water	712-01	Membrane Curing Compound	711-05
Wire Fabric For Concrete Reinforcing	709-02		
Expansion Bolt Anchors	GSA FF-S-325, Group III, Type 1 or Group VIII, Type 1		
Hook Bolts Inserted in Expansion Bolt Anchors	ASTM A307 Grade A		

**NOTE.** The wire fabric shall be galvanized in accordance with ASTM A641M regular coatings. The wire fabric shall be fabricated from No. 12 wire spaced 2 inches (nominal) in each direction or No. 10 wire spaced 3 inches (nominal) in each direction. Wire used shall have a minimum yield strength of 35 ksi.

#### 583-2.01 Equipment

**A. Batching and Mixing Equipment.** The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity.

**B. Air Supply.** The compressor shall be of adequate capacity to maintain a sufficient, constant nozzle velocity for all parts of the work while simultaneously operating a blow pipe for cleaning away rebound. The air hose shall be equipped with a filter to prevent any oil or grease from contaminating the shotcrete.

### C. Delivery Equipment

**1. Dry Mix Process.** The delivery equipment shall be capable of delivering a continuous, smooth, uniformly mixed material to the nozzle. The nozzle shall be equipped with a water ring and valve to permit adjustment of the water. The water added to the dry mix material at the nozzle shall be maintained at a pressure at least 16 psi greater than the air pressure. The nozzle shall be capable of delivering a conical discharge stream.

**2. Wet Mix Process.** Only pneumatic-feed type of delivery equipment will be allowed. Positive displacement type of equipment will be allowed pending a qualification test prior to the beginning of the work, which will also be the qualification test for the operator. The nozzle shall be equipped with an air ring for injecting compressed air into the material flow.

**583-2.02 Qualification Test.** If encasement of reinforcing bars is required, this test shall be performed to qualify the shotcrete operator and the equipment, prior to beginning work. Each shotcrete operator shall be qualified by constructing a 2 x 2 foot test panel fabricated to duplicate the project shotcreting. Reinforcement shall be placed in the panel to provide a minimum 1 inch (front and rear) embedment and be of the same size and spacing encountered in the structure. Panels shall be shot in the vertical, horizontal, and overhead positions as expected to be encountered. After setting, the test panel shall be broken open in a manner approved by and in the presence of the Engineer, to verify the reinforcement embedment. If voids are discovered, the work shall not proceed; additional panels shall be constructed until results acceptable to the Engineer are achieved. Small non-interconnected voids, as determined by the Engineer, shall not constitute failure.

Additional qualification panels will be required whenever, in the opinion of the Engineer, the shotcrete operation significantly changes.

### 583-3 CONSTRUCTION DETAILS

**583-3.01 Preparation of Surfaces.** All unsound concrete shall be removed until there are no offsets in the cavity which would cause an abrupt change in thickness, except for a transition from above to below reinforcement. Minimum 1/2 inch square shoulders shall be left at the perimeter of the cavity. The final cut surface shall be sound and properly shaped. The sound surface shall be blast cleaned. Abrasive material used for blastcleaning shall contain no more than one percent free silica by weight. Air clean the surface with oil-free compressed air. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface and all porous surfaces to be in contact with new concrete for 12 hours. This may be accomplished by continuous wetting with soaker hoses or the use of burlap/burlene/etc. where moisture can be maintained. If in the opinion of the Engineer conditions or the situation prohibits this then the surfaces should be wetted for as long as possible. Surfaces must be wetted by a means acceptable to the Engineer using potable water. The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete.

TABLE 583-1 SIZE AND SPACING OF HOOK-TYPE BOLTS (inches)		
Thickness of Placement	Underside & Vertical Surfaces Nominal Size and Spacing <sup>1</sup>	Topside Nominal Size and Spacing <sup>1</sup>
2	1/4 dia. @ 18 ctrs.	1/4 dia. @ ctrs. 24
4	3/8 dia. @ 24 ctrs.	3/8 dia. @ ctrs. 36
5	3/8 dia. @ 21 ctrs.	3/8 dia. @ ctrs. 36
6	3/8 dia. @ 20 ctrs.	3/8 dia. @ ctrs. 36

7	3/8 dia. @ 18 ctrs.	3/8 dia. @ ctrs. 36
8	1/2 dia. @ 23 ctrs.	1/2 dia. @ ctrs. 36
9	1/2 dia. @ 22 ctrs.	1/2 dia. @ ctrs. 36
10	1/2 dia. @ 21 ctrs.	3/4 dia. @ ctrs. 24
11	1/2 dia. @ 20 ctrs.	3/4 dia. @ ctrs. 24
12	1/2 dia. @ 18 ctrs.	3/4 dia. @ ctrs. 24

**NOTE:** 1. Bolt diameters may be increased but not decreased. Spacing may be decreased but not increased.

No material shall be placed if the ambient air, or concrete surface temperature is at, or below 45°F.

Reinforcement may consist of either existing reinforcing bars or welded galvanized wire fabric, depending on the conditions and shall be clean and free from loose mill scale, loose rust, oil or other coatings that interfere with bonding.

Chipping hammers shall meet the requirements of §580-3.02.

Sufficient clearance shall be provided around the reinforcement to permit complete encasement with sound shotcrete. The minimum clearance between the reinforcement and the form or other backup material shall be 1 inch.

Where the chipped area is equal to or less than 2 inches in depth, the use of wire fabric or mechanical concrete anchors will not be required except for overhead surfaces. Where the chipped areas are overhead, and are 1 inch in depth or greater, galvanized wire fabric and mechanical concrete anchors shall be used. Mechanical concrete anchors shall be placed as required by Table 583-1.

Where the chipped area is over 2 inches in depth and existing bar reinforcement is available, galvanized wire fabric shall be attached to the bars with tie wires. If existing bar reinforcement is not available, wire fabric shall be installed by means of mechanical concrete anchors in accordance with the requirements of Table 583-1.

Wire fabric shall be cut in sheets of the proper size and shall be carefully bent in such a manner as to follow closely the contours of the areas to be repaired. The wire fabric shall be securely tied to the hook-type bolts or the reinforcing bars.

Where sheets meet, they shall be lapped a minimum of 4 inches and shall be securely fastened together.

Expansion bolt anchors shall be placed in holes drilled in the existing concrete surface to the diameter and depth recommended by the manufacturer of the expansion bolt anchors. Hook-type bolts of the proper length shall be inserted and securely attached to the expansion bolt anchors so as to provide a positive connection to sound concrete.

Where the chipped area is 6 inches or greater in depth, the Contractor shall place galvanized wire fabric in layers 4 inches apart.

Where it is necessary to place more than one layer of galvanized wire fabric in an area to be repaired, the innermost layer shall be covered by a shotcreting prior to the installation of the next outermost layer.

Existing reinforcement which has lost significant section shall be repaired in a manner satisfactory to the Engineer as extra work.

### 583-3.02 Preparation of Materials

**A. General.** The sand shall be measured either by volume or weight, by means of batch boxes approved by the Engineer, or in a proportioning plant approved in accordance with section 501, Portland Cement Concrete - General. Wheelbarrows or shovels will not be permitted for measuring. The same source of sand shall be used throughout each structure.

**B. Dry Mix Process.** Dry mix shotcrete shall be composed of one part of cement to three to four and one-half parts of sand.

Prior to mixing, the moisture content of the sand shall be between 3 and 6%. The sand shall be dampened or dried as required to bring the moisture within these limits.

A wetting agent approved by the Engineer may be used at the Contractor's option in the dry mix process.

Sand-cement mixtures shall be applied within 75 minutes of the time the sand initially contacts the cement. Sand-cement mixtures which exceed the 75 minute limit shall not be incorporated in the work. They shall be disposed of in a manner acceptable to the engineer.

**C. Wet Mix Process.** Wet mix shotcrete shall be composed of one part of cement to three parts of sand. The cement, sand and water shall be premixed to a desired consistency and in accordance with §501-3.03, Handling, Measuring and Batching Materials, and §501-3.04, Concrete Mixing, Transporting and Discharges - General Requirements.

### **583-3.03 Placement**

**A. Weather.** Shotcrete shall not be applied during any precipitation which is of sufficient intensity to cause the placed shotcrete to run. Shotcrete shall not be placed during a wind that disrupts the nozzle spray.

Shotcrete shall not be applied when the ambient air temperature is below 45°F unless it is placed in accordance with §555-3.08C.2., Provision of External Heat. Receiving surfaces shall be heated to, and maintained at, approximately 45°F by a method approved by the Engineer before shotcreting operations begin. Under no conditions shall shotcrete be applied against surfaces upon which any frost adheres.

**B. Application.** Before starting to shoot, precautions shall be taken to protect property in the area. Adjacent construction, openings, shrubbery, and all areas that might be discolored or damaged by rebound, cement, water or dust must be covered with tarpaulins or plastic sheets to protect them from damage.

When projecting the shotcrete, the stream of flowing materials shall be directed from the nozzle as nearly at a right angle as possible to the surface being treated, and shall be held uniformly at the same distance, less than 5 feet away from the surface at all times. Manufacturer's recommendations shall be followed. The size of the nozzle shall be consistent with the manufacturer's recommendation for the maximum size of the sand used. The use of rebound material shall not be permitted.

Shotcrete on vertical and overhead surfaces shall be built up in 3/4 inch maximum layers to prevent sloughing in heavy applications. Succeeding layers shall be applied just prior to the initial set to maintain a good bond.

When encasing reinforcing steel, the stream from the nozzle shall be directed at an angle so as to fill the space behind the bars. An air jet shall be used to blow out any rebound ahead of the application of shotcrete. Should any such deposit of sand rebound be covered with shotcrete, it shall be cut out and removed by the Contractor without compensation.

Ground wires may be installed to establish the thickness and surface planes of the shotcrete build up. Both horizontal and vertical ground wires may be installed at corners and offsets not clearly established by exterior corners of walls, column or beam corners, and other locations. They may also be used as screed guides. Eighteen or 20 gage hard steel piano wire is recommended for this purpose. Ground wires shall be tight and true to line, and placed in such a manner that they may be further tightened.

**C. Quality Control**

**1. Test Panels.** This test shall be used to determine the physical quality of the shotcrete and shall be performed immediately before shotcreting operations begin, after each additional 100 sf, and immediately after operations are ended.

The test panels shall be 12 inches square, 3/4 inch thick plywood boards with galvanized mesh (1/2 inch square openings) strips projecting 4 inches attached around the perimeter of the board. The boards shall be erected horizontally, vertically, or overhead, depending on the anticipated shooting positions. The shotcrete operator shall completely fill the test panel, after which it shall be screeded or cut with a trowel such that it contains a 4 inches uniform depth of shotcrete. The test panels shall then be covered with wet quilted covers or wet polyethylene-coated blankets; put in a shaded, protected place; kept wet and cured for a minimum of seven days. The test panels shall be sent to the Department of Transportation's Materials Bureau for testing at fourteen days. Cores will be drilled from the panels and compressive strengths at fourteen days will be reported to the Engineer. Additional information on the conditions of the shotcrete such as sand pockets, voids, and laminations will also be reported with the strength results.

**2. Coring.** The Contractor shall take a core, at a location determined by the Engineer, from each structural element, such as pier, abutment, arch, etc., to verify acceptability of reinforcement encasement. Cores which do not contain reinforcing bars will not be used to determine encasement acceptability. If interconnected voids are found, the structural element represented by that core shall be rejected. All rejected shotcrete shall be repaired or replaced at the Contractor's expense. Repair methods shall be proposed by the Contractor for approval by the Engineer. The Contractor may take additional cores at locations approved by the Engineer to establish the limits of rejected work. The additional coring shall not jeopardize the design integrity of the structural element. If additional cores are not taken, all work on that structural element shall remain rejected. Core holes shall be patched with an applicable concrete repair material from the Approved List.

**D. Finishing.** The natural gun finish will be sufficient unless the plans call for one of the following finishes:

**1. Screed Finish.** After the surface has taken its initial set, excess material outside the forms and ground wires shall be sliced off with a sharp-edged cutting screed. After screeding, the ground wires shall be removed.

**2. Broom Finish.** This type of finish may be applied after screeding.

**3. Flash Coat Finish.** This is a thin surface coating containing finer sand than normal, and the application nozzle is held well back from the work. This finish shall be applied to the surface as soon as possible after screeding.

Any of the remaining three types of finish may be applied following flash coat:

*a. Wood Float Finish.* This gives a granular finish.

*b. Rubber Float Finish.* This gives a coarse finish.

*c. Steel Trowel Finish.* This gives a very smooth finish.

**E. Curing.** Curing shall be in accordance with §555-3.08, Curing, and the following modifications:

- All curing covers shall be pre-wet and kept wet during the entire curing period in a manner satisfactory to the Engineer.

- Curing compounds shall be applied twice. The second application shall be done when the first application has become tacky. The second application shall be done at a right angle to the first application. The rate of each application shall be that given in §555-3.08A.

**583-4 METHOD OF MEASUREMENT.** The quantity to be paid for under this item will be the number of square feet of finished shotcrete installed. Measurement will be taken as the plane projection of the finished surface. Measurement shall be made prior to the placement of shotcrete.

**583-5 BASIS OF PAYMENT.** The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

**583-5.01 Removal of Structural Concrete - Replacement with Shotcrete.** No Reinforcement Bar Encasement. The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

**583-5.02 Removal of Structural Concrete - Replacement with Shotcrete, Reinforcement Bar Encasement.** The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that replacement of deteriorated reinforcement shall be paid for separately. Payment shall not be made until cores verify acceptability.

*Payment will be made under:*

Item No.	Item	Pay Unit
583.02	Removal of Structural Concrete - Replacement with Shotcrete, No Reinforcement Bar Encasement	Square Foot
583.03	Removal of Structural Concrete - Replacement with Shotcrete, with Reinforcement Bar Encasement	Square Foot

## SECTION 584 - SPECIALIZED OVERLAYS FOR STRUCTURAL SLABS

**584-1 DESCRIPTION.** Prepare the surfaces that will be in contact with slab reconstruction concrete and place slab reconstruction concrete. Prepare the structural slab surface and place a specialized concrete overlay.

**584-1.01 Scope.** Concrete removal work will be paid for under the appropriate item(s). Minimum thickness of overlay concrete is 1 1/2 inches. Include the cost of any grade changes necessitated by this requirement in the unit bid price for overlay concrete. Use only one type of overlay concrete on any one structure.

### 584-1.02 Definitions

**A. Class DP Concrete.** A homogeneous mixture of portland cement, fly ash, microsilica admixture, fine and coarse aggregates, air entraining agent, set retarding water reducing admixture and water.

**B. Microsilica Concrete.** A homogeneous mixture of portland cement, microsilica admixture, fine and coarse aggregates, air entraining agent, high range water reducing admixture and water.

**C. Overlay Concrete.** Concrete placed over existing and slab reconstruction concrete. Overlay concrete will be Microsilica concrete for Method 1 and Method 2, and Class DP concrete for Method 3, as described in 584-1.03 Placement Methods.



**D. Slab Reconstruction Concrete.** Concrete placed completely around the exposed top mat of bar reinforcement. Slab reconstruction concrete will be Class D or Class DP concrete for Method 1, Microsilica concrete for Method 2, and Class DP concrete for Method 3, as described in 584-1.03 Placement Methods.

**E. Positive-tie-downs.** Anchors drilled into the structural slab and connected to reinforcing steel.

### **584-1.03 Placement Methods.**

**A. Method 1 - Separate Placement.** Place Class D or Class DP slab reconstruction concrete and Microsilica overlay concrete separately. Use only one type of slab reconstruction concrete on each placement.

**B. Method 2 - Integral Placement of Microsilica Concrete (Optional).** When all of the following conditions are satisfied, Microsilica overlay concrete and Microsilica slab reconstruction concrete may be placed in a single lift:

- The area of the exposed top mat of bar reinforcement is 5% or less of the placement area, per span.
- No individual area of the exposed top mat of bar reinforcement exceeds 25 sf.
- No dimension of any area of the exposed top mat of bar reinforcement exceeds 6 feet.

**C. Method 3 - Integral Placement of Class DP Concrete (Optional).** When 100% of the top mat of bar reinforcement is exposed, Class DP overlay concrete and Class DP slab reconstruction concrete may be placed in a single lift.

## **584-2 MATERIALS**

**584-2.01 General.** All materials listed in §557-2 with the following:

**A. Air Entraining Admixture.** §711-08 with the following: For Microsilica concrete, use only a vinsol resin-based air entraining agent.

**B. Microsilica Admixture**

1. Follow the requirements of §501-2 and §501-3.01.
2. Samples will be taken in accordance with Materials Method 9.1M and Materials Procedure 90.1.
3. Blended Portland Cement, §701-03 (Type SF) may also be used for the Portland cement/microsilica portion of the Class DP and the Microsilica Concrete designed mix.

**C. (Vacant)**

### **584-2.02 Manufacture of Class DP Concrete**

**A. Proportioning.** The initial ingredient proportions, except for admixtures, are given in TABLE 584-1.

**B. Handling, Measuring and Batching.** Follow the requirements of §501-3.02 and §501-3.03, except that water reduction must be accomplished using only a water-reducing and retarding admixture (§711-08, ASTM Type D). If a microsilica slurry is used, include the slurry water as mix water.

<b>TABLE 584-1 MIX CRITERIA - CLASS DP CONCRETE</b>	
Cement Content (lb/cy)	536
Fly Ash Content (lb/cy)	145
Microsilica Content (lb/cy)	44
Sand Percent Total Aggregate (solid volume)	45.8
Designed Water/Total Cementitious Content	0.4
Desired Air Content (%)	7.5
Allowable Air Content (%)	6.0 - 9.0
Desired Slump (inches)	4
Allowable Slump (inches)	2 - 5
Type of Coarse Aggregate Gradation	CA 1

**NOTE:** The criteria are given for design information and the data is based on a fine aggregate modulus of 2.80 and a CA1 coarse aggregate gradation. Adjust the mixture proportions using actual fineness modulus and bulk specific gravities (saturated surface dry for aggregates). Compute the adjustments according to Department instructions.

### 584-2.03 Manufacture of Microsilica Concrete

**A. Proportioning.** The initial ingredient proportions except for admixtures are in TABLE 584-2.

<b>TABLE 584-2 MIX CRITERIA - MICROSILICA CONCRETE</b>	
Cement Content (lb/cy)	657
Microsilica Content (lb/cy)	61
Sand Percent Total Aggregate (solid volume)	53
Designed Water/Total Cementitious Content	0.37
Desired Air Content (%)	6.5
Allowable Air Content (%)	5.0 - 8.0
Desired Slump (inches)	4
Allowable Slump (inches)	2 - 6
Type of Coarse Aggregate Gradation	CA 1

**NOTE:** The criteria are given for design information and the data is based on a fine aggregate modulus of 2.80 and a CA1 coarse aggregate gradation. Adjust the mixture proportions using actual fineness modulus and bulk specific gravities (saturated surface dry for aggregates). Compute the adjustments according to Department instructions.

**B. Handling, Measuring and Batching.** Follow the requirements of Subsection 501-3.02 and -3.03, except that water reduction must be accomplished using only a High-Range Water-Reducing Admixture (§711-08, ASTM Type F). Add the High-Range Water Reducer at the batching facility.

The Regional Materials Engineer may allow a maximum of two additions of water and/or admixture at the work site. Provide an additional 30 mixing revolutions for each addition of water and/or admixture. However, once the concrete has reached the desired slump, only the High-Range Water Reducer may be used to adjust the concrete slump. The maximum total mixing revolutions is 200. Observe the Manufacturer's maximum dosage rate for the admixture, regardless of where the admixture is added. If a microsilica slurry is used, include the slurry water as mix water.

### 584-2.04 Equipment

**A. Microsilica Admixture.** Follow Subsection 584-2.01B.

**B. Finishing Machine.** A finishing machine capable of self propulsion in forward and reverse, raising the screeds above the screeded surface when traveling in reverse, and meeting one of the two sets of requirements below.

**1. Roller Screed.** Must be equipped with a power driven strike-off auger, power driven finishing roller, vibrating pan or roller producing 3000 to 7000 vpm, and pan float.

**2. Dual Oscillating Screed.** Must be equipped with at least 2 oscillating screeds producing between 3000 and 7000 vpm, strike-off auger, and control of each screed's vertical position and tilt angle.

The specific method and equipment used for finishing will be approved by the Regional Construction Engineer before use. Provide access to the machine at the work site for one working day, for inspection by the Engineer. Have a qualified Finishing Machine Operator present at the time of inspection. Two weeks prior to the inspection date, provide the Engineer with a copy of the operating manual for their exclusive use.

Use supporting rails with no bends or kinks. Support the rails with fully adjustable supports (no shims), spaced a maximum of 12 inches on center. When placing concrete adjacent to a completed placement, set the supporting rails for one side of the finishing machine on the completed placement.

**C. Recording Thermometer.** A continuous recording thermometer capable of measuring temperatures in the range of 30°F to 100°F for a minimum of 24 hours. Include the cost of calibration in the unit price bid.

**D. (Vacant)**

## **584-3 CONSTRUCTION DETAILS**

### **584-3.01 Limitation of Operations**

- A. No structural concrete removal work is permitted in areas adjoining new concrete during the new concrete's specified curing period.
- B. No loads, other than construction loads which are less than 2 tons and approved by the Engineer, are permitted on areas of the structural slab where concrete has been removed.
- C. No loads are permitted on concrete until completion of the specified curing period.

### **584-3.02 Blast Cleaning**

- A. Blast clean all surfaces to be in contact with new concrete. Remove all grease and dirt. Remove all rust and mortar which is not firmly bonded to the surface being cleaned. Rust and concrete deposits which are firmly bonded and cannot be removed by blast cleaning may remain. A light coating of orange rust, that forms on steel surfaces after blast cleaning, is not considered detrimental to bond and may remain. Remove all debris created by blast cleaning.
- B. Place reinforcing steel supports and positive-tie-downs at a maximum spacing of 4 feet.
- C. Repeat blast cleaning if more than 48 hours pass before concrete placement begins.

**584-3.03 Preplacement Wetting.** After blast cleaning has been accepted, thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the deck from drying, so the concrete remains in a saturated surface dry condition.

#### **584-3.04 (Vacant)**

**584-3.05 Handling and Placing Concrete.** §557-3.05 and §557-3.12 with the following:

- A. Place concrete only when the ambient air temperature and deck surface temperature (after wetting) will be below 85°F during the entire placement.
- B. Place overlay concrete only if preplacement wetting has been completed on an area large enough to require one working day for placement, at least one span length.
- C. When using concrete transporting devices on a prepared surface, protect exposed reinforcing steel from deformation and prevent contamination of the surface.
- D. If operations are delayed for more than 30 minutes, install a construction dam or bulkhead. If placement operations are delayed for more than 60 minutes or if the concrete attains initial set, discontinue placement for at least 48 hours. This restriction does not prohibit continuation of the placement provided a gap is left in the placement. This gap is to be sufficient in length to allow the finishing machine to clear the previously placed concrete. Prepare the gap area for concrete placement in accordance with this specification, after the previously placed concrete, on both sides of the gap, has cured for 48 hours.

#### **584-3.06 Finishing and Curing**

**A. Slab Reconstruction Concrete - Separate Placement.** §557-3.09 and §557-3.11 with the following:

- 1. For areas less than 25 sf, hand finishing of slab reconstruction concrete is acceptable. For areas greater than 25 sf, use either a manually driven vibrator equipped power screed from the Department's Approved List or the same machine to be used to finish the overlay.
- 2. Screed to the level of the surrounding concrete. When 100% of the reinforcing steel is exposed, screed to a minimum 3/8 inch above the reinforcing steel. Roughen the screeded surface with a tining rake or similar device.
- 3. Cure concrete with wet burlap for 3 days. Provide uniform continuous wetting until concrete curing is complete. The wet burlap and curing cover option is not allowed.
- 4. Blastclean the surface, according to §584-3.02, after the curing period is over, but prior to wetting. Expose approximately 50% of the surface coarse aggregate, and leave an irregular texture.

**B. Overlay Concrete.** §557-3.08, §557-3.11, and §557-3.12 with the following:

- 1. Finish overlay concrete to a minimum depth of 1 1/2 inches and a minimum total cover over top mat of bar reinforcement of 2 3/8 inches. Use a finishing machine meeting the requirements of this specification.
- 2. Machine finish the concrete within 10 minutes of its deposition onto the deck. If the machine cannot finish the concrete within the 10 minute time limit, stop all further placement, immediately cover the fresh concrete with plastic curing covers, and keep the unfinished concrete covered until it is machine finished. Once concrete being placed can be machine finished within the 10 minute time limit, resume placing concrete.
- 3. Apply curing within 10 minutes after machine finishing. Provide uniform continuous wetting until concrete curing is complete. Cure Microsilica concrete with wet burlap for 4 days. Cure Class DP concrete with wet burlap for 7 days. The wet burlap and curing cover option is not allowed.

**584-3.07 Construction Joints.** For the purpose of this specification, construction joints provide for interruptions in overlay concrete placement.

At transverse and longitudinal construction joints, place the overlay concrete a distance at least equal to the depth of the overlay, beyond the intended joint location. After the overlay concrete has cured for 48 hours, sawcut along the joint to a depth of 3/4" ± 1/8 inch. Chip the extra overlay concrete to the level of the original prepared surface at a 45° angle. Do not undercut existing concrete.

**584-3.08 Defective or Damaged Concrete.** §557-3.16 with the following:

A. Defects and damage, for the purposes of this specification, are imperfections caused by the Contractor's operations, including, but not limited to: cracking, tearing, and open areas. Repair all defective or damaged concrete at no cost to the Department, using the same class of concrete originally placed.

B. Make all repairs rectangular in plan shape and as close to square as possible. Sawcut the perimeter of the repair to a depth of 3/4" ± 1/8 inch. Chip out the damaged or defective concrete to the level of the original prepared surface. Angle the walls of the repair cavity at 45° toward the center of the repair. Do not undercut existing concrete. Prepare the surfaces of the repair cavity and place new concrete in accordance with this specification.

**584-4 METHOD OF MEASUREMENT.** For placements with 100% exposure of the top mat of bar reinforcement, the number of square yards of slab reconstruction concrete will be equal to the number of square yards of overlay concrete.

For placements with less than 100% exposure of the top mat of bar reinforcement, measure slab reconstruction concrete prior to overlay concrete placement.

**A. Method 1 - Separate Placement.** Measure slab reconstruction concrete as the number of square yards of Class D or Class DP slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Microsilica overlay concrete placed.

**B. Method 2 - Integral Placement of Microsilica Concrete (Optional).** Measure slab reconstruction concrete as the number of square yards of Microsilica slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Microsilica overlay concrete placed.

**C. Method 3 - Integral Placement of Class DP Concrete (Optional).** Measure slab reconstruction concrete as the number of square yards of Class DP slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Class DP overlay concrete placed.

**584-5 BASIS OF PAYMENT.** Include the cost of all labor, materials and equipment necessary to complete the work in the unit bid price.

**Payment will be made under:**

Item No.	Item	Pay Unit
584.3001nn	Overlay Concrete, Microsilica Concrete – Type 1 Friction	Square Yard
584.3002nn	Overlay Concrete, Microsilica Concrete – Type 2 Friction	Square Yard
584.3003nn	Overlay Concrete, Microsilica Concrete – Type 3 Friction	Square Yard
584.3009nn	Overlay Concrete, Microsilica Concrete – Type 9 Friction	Square Yard
584.3101nn	Overlay Concrete, Class DP – Type 1 Friction	Square Yard
584.3102nn	Overlay Concrete, Class DP – Type 2 Friction	Square Yard
584.3103nn	Overlay Concrete, Class DP – Type 3 Friction	Square Yard
584.3109nn	Overlay Concrete, Class DP – Type 9 Friction	Square Yard
584.3200nn	Slab Reconstruction Concrete, Class D, DP or Microsilica Concrete	Square Yard

NOTE: nn denotes a serialized pay item.

## SECTION 585 - STRUCTURAL LIFTING OPERATIONS

(Last Revised May, 2019)

**585-1 DESCRIPTION.** This work shall consist of raising, supporting, and lowering each designated bearing point to perform the tasks specified in the contract documents. This work shall also include the temporary shoring of a bearing point where a shim tight installation is designated on the plans. Examples of work specifying a shim tight installation include, but are not limited to:

- Temporary shoring of capbeams during staged construction.
- Temporary shoring of girders during substructure rehabilitation.
- Temporary shoring of a bridge construction stage to decrease or eliminate live load deflection.

**585-1.01 Bearing Point.** The term bearing point is defined as a point on the structure which is designated on the plans to be raised or shored to perform other work.

**585-1.02 Lift Point.** The term lift point is defined as a point on the structure where the lifting force is applied.

**585-1.03 Type.** The type designation is used to distinguish between different methods of accomplishing the work, and/or significantly different lifting loads. Such situations will be noted on the contract plans. They will be defined by a type designation. The type designation will be reflected in the pay item title (e.g., 585.01 Structural Lifting Operations - Type A, etc.).

### 585-2 MATERIALS

**585-2.01 Used Materials.** Used materials will be allowed. Those materials that are permanently attached to the structure shall be new, and meet the requirement of the *New York State Steel Construction Manual* and the following requirements:

Structural Steel	715-01
High Strength Bolts, Nuts and Washers	715-14
Pins and Rollers	715-15

**585-2.02 Lifting Equipment.** Unless otherwise specified in the contract documents or plans, the choice of structural lifting system and/or temporary shoring shall be at the Contractor's option, subject to the following provisions:

Jacks used for lifting operations shall have the rated capacity clearly shown on the manufacturer's name plate attached to each jack. Jacks shall have a rated capacity of a least one and a half times the calculated lifting force. Lifting equipment deemed to be inadequate or faulty shall be removed from the site.

Jacks shall be equipped with pressure gauges or other load measuring devices that will enable the applied lifting force to be monitored. Jacks and associated lifting equipment shall be calibrated as per manufacturer's instructions.

### 585-3 CONSTRUCTION DETAILS

**585-3.01 General.** Unless a specific distance is shown on the plans, each designated bearing point shall be raised the minimum distance that will allow the work to be completed.

The Contractor shall engage the services of a Professional Engineer to design and detail the structural lifting system and/or temporary shoring. The Professional Engineer shall be available for

consultation in interpreting their plans and in the resolution of problems which may arise during the performance of the work. The Contractor and the Professional Engineer shall be intimately familiar with the current condition of the existing superstructure with respect to the structural capacity of the members.

All field welding and slip critical connections shall be performed in accordance with the *New York State Steel Construction Manual*. For slip-critical connections, the class of slip resistance shall be specified on the working drawings.

The Contractor shall furnish lift plans and calculations for the installation of the structural lifting system and/or temporary shoring structural elements as per the requirements in §107-05 P.2 *Lift Plans*. If drilling and grouting into existing concrete is included as part of the structural lifting system, the DCES will determine the need for pull-out testing based on *The New York State Bridge Manual*. A non-destructive investigation shall be performed by the Contractor to determine the location of existing reinforcing steel prior to drilling. If reinforcing steel conflicts with, or is encountered during the drilling operation, the DCES shall be notified by the Contractor to determine the appropriate course of action. At no time shall reinforcement be cut without the approval of the DCES. All drilling and grouting operations shall comply with *Section 586 Miscellaneous Structural Reconstruction*. Spalled concrete in areas to be drilled and grouted shall be repaired prior to the installation of the lifting equipment.

If drilling and grouting into repaired spalled concrete, the embedment depth, subject to the contractor's engineer's approval, may only include the depth of repair behind the reinforcement. If the drilling and grouting is into unreinforced concrete, the embedment depth shall be measured into existing sound concrete only, and shall not include the depth of the repair.

**585-3.02 Loads.** The contract documents designate, by type, the bearing points to be raised or shored to perform the contract work. The unfactored loads at each bearing point are shown in the contract documents. The Contractor and the Professional Engineer shall determine the appropriate lateral and longitudinal loads in the design of the structural lifting system and/or temporary shoring. The Contractor shall select the location of the lift points, subject to the approval of the DCES, and calculate the required lifting force at that location.

All design and details shall be in conformance with the current AASHTO Guide Design Specifications for Bridge Temporary Works, with the following revisions:

- Loads and load combinations shall be from either the current AASHTO Standard Specifications for Highway Bridges or the AASHTO LRFD Bridge Design Specifications.
- There shall be no required minimum vertical design load.
- The maximum slenderness ratio for steel structural lifting compression members shall be 120.
- The presumptive soil bearing values shown in Table 2.5.2-1 shall not apply for footings located on slopes exceeding a 1 vertical on 6 horizontal. In these cases, designs should be based on either the current AASHTO Standard Specifications for Highway Bridges or the AASHTO LRFD Bridge Design Specifications.

Structural lifting system and/or temporary shoring submittals shall be designed to Inventory Level. Operating Level designs will not be allowed. The design of the structural lifting system shall include a narrative of how lateral and longitudinal stability of the structure is maintained while in a supported position.

**585-3.03 Working Drawings.** The Contractor shall furnish legible working drawings, prepared, sealed and signed by a Professional Engineer, for the system proposed to raise, support, and lower, or temporarily shore each designated bearing point. The working drawings shall not alter the number or location of designated bearing points shown on the contract documents.

The working drawings shall include, but are not limited to the following:

- Lift point locations
- Unfactored calculated lifting forces and equivalent pressures for the following two conditions:

- Anticipated structure liftoff
- Maximum capacity of the entire lifting system
- Details for all lifting equipment and temporary shoring systems
- Sequence of lifting operations
- Type and grade of all materials
- Distance that each bearing point is to be raised
- Schematic hydraulic layout
- All disconnections, reconnections or adjustments that are necessary to properly complete the lifting operations. This includes, but is not limited to, railings, joints, power lines, gas lines, water lines, etc.
- Scour protection of supports for lifting and/or shoring in, or adjacent to, waterways. Scour protection shall be, at minimum, medium stone fill.
- Positive connection to the existing structure

Working drawings and design computations shall be submitted electronically to the DCES, with a copy to the Engineer, for approval. The DCES shall be allowed the longest of the following time durations to examine design computations and working drawings:

- Fifteen work days.
- Two work days for each drawing of a set of working drawings.
- One work day for every four (4) design computation sheets. Any design computation sheet written on both sides will be considered as two design computation sheets.

Time for review will begin upon receipt of all pertinent information by the DCES.

The DCES comments will be indicated on the returned copies. Should the proposed system not be approved, the reasons will be indicated with the return of the material. The Contractor shall submit revised drawings and design computations for approval, subject to the same terms as the first submission. Resubmission will not be considered a reason to request an extension of time. The review of the design calculations and working drawings by the Department shall not relieve the Contractor of any responsibility for safely and adequately designing and installing the lifting system and/or temporary shoring.

All work shall be done in accordance with the approved working drawings. The Contractor must have approved working drawings prior to the start of any structural lifting operations. The Contractor shall bear all costs and/or damages which may result from the ordering of any materials, or equipment; or the use of any preparatory labor prior to the approval of the working drawings.

**585-3.04 Lifting Operations.** The Contractor shall raise each designated bearing point by applying the necessary lifting force at each lift point. If the anticipated structure liftoff pressure is reached prior to the structure lifting, the structural lifting operation shall stop. The Contractor and its Professional Engineer shall investigate the causes of why the structure failed to lift. Concurrence from the Engineer must be obtained prior to restarting the lifting operation. The Contractor shall not apply a lifting pressure in excess of the calculated maximum allowable lifting pressure stated on the working drawings.

During all phases of the operation, the differential lift between any two adjacent bearings on a common centerline of bearing shall not exceed  $\frac{3}{8}$  inch unless approved by the DCES.

The Contractor shall, at the earliest possible moment during or after each lift, safely secure the structure with shims, cribbing, bolsters, or other suitable supports. After the structure has been raised the structural lifting system shall be positively connected to the existing structure.

The lifting operation shall be conducted such that the distance between the structure and the shims, cribbing, bolsters, or other suitable supports shall not exceed  $\frac{3}{8}$  inch at any time.



Any replacement, repair, or adjustments to the superstructure steel due to the structural lifting operations shall be performed in accordance with the current *New York State Steel Construction Manual*.

All materials required for temporary support of the structure shall remain the property of the Contractor and shall be removed from the site after the work is completed.

**585-3.05 Inspection.** Structural lifting systems, and temporary structural supports, that are to remain in place for a period exceeding one year shall be inspected by a Professional Engineer hired by the Contractor. The Professional Engineer shall certify in writing to the Engineer that the structural system can continue to function as originally designed.

**585-4 METHOD OF MEASUREMENT.** The quantity to be measured for payment will be the number of bearing points raised.

**585-5 BASIS OF PAYMENT.** The unit price bid per bearing point shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Payment will be made only once for each bearing point regardless of the number of times the bearing point is raised.

Progress payments will be made after all temporary supports have been installed and any required lifting has been performed. Payment will be made for 70 percent of the quantity. The remaining 30 percent will be paid for after the bearing points have been lowered to their final permanent position and the lifting equipment and temporary supports have been removed.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
585.XX	Structural Lifting Operations - (Types A - K)	Each
	<i>XX (01 through 11) = Type Designation (A through K)</i>	

## **SECTION 586 - MISCELLANEOUS STRUCTURAL RECONSTRUCTION**

(Last Revised September, 2019)

### **586-1 DESCRIPTION**

**586-1.01 Drilling and Grouting Anchors.** This work shall consist of drilling and grouting anchors. For the purposes of this specification, the term ‘anchors’ refers either to bolts or to reinforcing bars, as appropriate. When the item number indicates Pull-Out Testing is required, all anchors shall be paid for under that item number regardless of whether they are selected to be tested.

**586-1.02 Removal of Rivets-Replacement with High Strength Bolts.** This work shall consist of removal of rivets and replacement with high strength bolts.

**586-1.03 Field Drill Holes in Existing Structural Steel.** This work shall consist of field drilling holes in existing structural steel that is in service prior to the beginning of construction.

### **586-2 MATERIALS**

**586-2.01 Drilling and Grouting Anchors.** Grout Material used in Permanent applications where a sustained tensile load will exist, shall conform to §701-05 *Concrete Grouting Material*. Grout used in other applications shall conform to either §701-07 *Anchoring Materials - Chemically Curing* or §701-05 *Concrete Grouting Material*. Chemically curing anchoring materials or adhesives are referred to herein as grout.

Permanent and temporary installations using Anchoring Materials – Chemically Curing shall be designed using the current edition of ACI 318 for the given loading conditions.

Anchoring Materials – Chemically Curing shall not be used in permanent applications where

sustained tensile loads will exist, including but not limited to all horizontal or overhead applications, as well as all angles in between. Installation of anchors for Bridge railing, decorative railing, pedestrian fence and screening are not typically subject to sustained tensile loads. Some cantilever applications can produce sustained tensile loads, and chemically curing anchors shall not be used in these applications.

When such work is required, alternative anchoring methods or materials such as mechanical anchors or cementitious grouting operations shall be used in these locations. Use of alternate materials or methods not previously approved shall require approval of the Deputy Chief Engineer Structures (DCES).

Anchoring Materials – Chemically Curing may be used for temporary applications, as a part of a design sealed and signed by a Professional Engineer.

**586-2.02 Removal of Rivets - Replacement with High Strength Bolts.** High strength bolts, nuts and washers shall meet the requirements of §715-14 *High Strength Bolts, Nuts and Washers*. If paint color is not specified, the color selected shall match the existing paint. Paint shall meet the requirements of §708-02, *Structural Steel Paint - Class 2*.

**586-2.03 Field Drill Holes in Existing Structural Steel.** None Specified.

### **586-3 CONSTRUCTION DETAILS**

**586-3.01 Drilling and Grouting Anchors.** All holes shall be drilled by means of a rotary impact drill. Except as indicated below, if reinforcing steel is encountered, the reinforcing steel shall be cut and removed by means of a core drill. The remainder of the drilling shall be done with the rotary impact drill. Where plans indicate significant design reinforcement, a non-destructive investigation shall be done to determine the location of existing reinforcing steel prior to drilling. If after the non-destructive investigation, reinforcing steel is determined to be in conflict with, or encountered during the drilling operation, the DCES shall be notified to determine the appropriate course of action.

The Contractor shall not perform drilling with a lubricant, except in this case water is not considered a lubricant. Drilling methods shall not cause spalling, or other damage to concrete. Concrete spalled, or otherwise damaged by the Contractor's operations shall be repaired at no additional cost to the State.

Holes shall be surface dry and shall have had all foreign and loose material removed immediately prior to grout placement. Prior to anchor placement in the grouted hole, all material which might interfere with bond between the anchor and the grout shall have been removed. This includes, but is not limited to: moisture, grease, dirt, mill scale and rust. Rust which cannot be removed from the anchor even by vigorous scrubbing with a wire brush is considered firmly bonded and may remain, unless more specific instructions are provided in the manufacturer's installation procedures. The depth of hole and hole diameter shall be in accordance with the grout manufacturer's recommendation, and shall consider: anchor diameter, strength of existing concrete, anchor spacing and edge distance. The distance from the bottom of the hole to the nearest free surface of a structural element, shall be at least 1 5/8 inches or as recommended by the manufacturer, whichever is greater. The length of any plastic sleeve used as an aid to grout placement shall not be included in the length of the hole. The Contractor may increase the embedment length beyond that required by the contract documents if approved by the Engineer, at no additional cost to the State.

Grout shall be stored, mixed, and placed in accordance with the manufacturer's instructions. No grout shall be placed at a temperature outside the range recommended by the grout manufacturer.

Anchors shall be inserted full depth into the grouted hole and shall be manipulated or rotated in accordance with the Manufacturer's recommendations to ensure complete coverage of the embedded anchor with grout. After insertion of the anchor, all excess grout shall be struck off flush with the concrete face. Care shall be taken to prevent grout from running out of the drilled hole. Should the grout fail to fill the hole after anchor insertion, additional grout shall be added immediately after insertion of the anchor to allow a flush strike-off.

If the anchor is inserted in a hole with an axis that is predominantly horizontal, care shall be taken to prevent grout from running down the face of the concrete.

All uses of Anchoring Materials - Chemically Curing, both permanent and temporary, shall be installed by a certified ACI/CRSI Adhesive Anchor Installer.

Temporary applications using §701-07 Anchoring Materials - *Chemically Curing* shall be inspected by the Contractor every 90 days at a minimum to ensure that the adhesive anchor is performing as intended. The Contractor shall check for such things as creep of anchor material, movement of the anchors, loose bolts, loose nuts, etc. Temporary items anchored using §701-07 Anchoring Materials – Chemically Curing shall be removed or abandoned, in such a way that the anchors are no longer subject to any load upon completion of their temporary use.

**A. Anchor Pull-Out Testing.** Table 586-1 *Number of Anchors to be Pull-Out Tested* gives the number of anchors (N1) to be tested for any lot size. The Engineer will randomly choose the anchors to be tested. Testing of anchors in a lot shall not begin until all the anchors in the lot are installed. If one (N1) anchors fails, N2 indicates the number of additional anchors that must be tested. If only one anchor fails (N1+N2), the lot will be accepted. If more than one anchor fails, all remaining anchors must be tested.

A lot size is determined by the Contractor, but must meet the following criteria:

1. A lot size shall not exceed 600 anchors.
2. All anchors in a lot must be installed within a two-month period.
3. Any anchors installed beyond the two-month period set forth in 2 above shall be part of another lot.
4. A lot shall only include anchors grouted with a single product
5. A lot shall only include anchors of the same type, diameter and embedment depth.

<b>Table 586-1 NUMBER OF ANCHORS TO BE PULL-OUT TESTED</b>		
<b>LOT SIZE</b>	<b>N1</b>	<b>N2</b>
1-30	All the anchors in the lot	-
31-50	30	All remaining anchors
51-75	38	All remaining anchors
76-100	44	21
101-200	49	26
201-300	50	30
301-600	55	30

**B. Test Equipment.** The test equipment shall consist of a load cell, jacking system, a frame to distribute the jack load, couplers to connect the jack to the anchors, and appropriate safety devices. A calibrated pressure gauge with hydraulic ram is equivalent to a load cell. Prior to starting the testing, the Contractor shall supply the Engineer with a certificate of calibration for the load cell performed within the previous six months by an independent testing agency. Supports for the frame used to distribute the jack load shall be located outside a circle centered at the anchor. The circle shall have a diameter equal to 2 inches plus twice the anchor embedment length, but need not exceed 24 inches. The frame and jack shall be positioned so that the load is applied along the axis of the anchor. Chains or cables shall be used to connect the various pieces of the tensioning system so that free flying projectiles will not be created by the failure of an anchor coupling or other portion of the testing system.

**C. Test Load.** The test load for bolts shall be 90% of the ASTM proof load. When no proof load is given in the ASTM specifications for the bolt, the test load shall be the yield strength. The test load for reinforcing bar shall be 90% of the yield strength. Table 586-2, *Anchor Pull-Out Test Loads* lists the test loads for the most commonly used anchor bolts and rebar steels.

Table 586-2 ANCHOR PULL-OUT TEST LOADS			
ASTM F3125 GRADE A325 or ASTM A449 Bolts (Coarse-Threaded Full Length)		ASTM A615 Grade 60 Reinforcing Bars	
Diameter (inches)	Test Load (kips)	Size	Test Load (kips)
1/2	11	4	11
5/8	17	5	17
3/4	26	6	24
7/8	35	7	32
1	46	8	43
1 1/8	51	9	54
1 1/4	65	10	69
		11	84
		14	122

Note: this load testing is designed to be non-destructive. Loading shall be stopped as soon as the test load is reached.

Anchors pass if the specified test load is attained without permanently displacing the anchors. Concrete spalled or otherwise damaged by the load testing shall be repaired at no additional cost to the State. All anchors which fail a load test, or are otherwise damaged, shall be replaced at no additional cost to the State. All replaced anchors shall be successfully load tested.

**586-3.02 Removal of Rivets-Replacement with High Strength Bolts.** If the existing steel is painted, prior to the beginning of any other work operations, the paint shall be removed for a minimum distance of 4 inches on each side of the centerline of work location in accordance with the requirements of Section 574 *Structural Steel Painting: Localized*.

Rivets shall be removed by one of the following methods: Shear rivet head using a pneumatic rivet breaker (helldog), and drive out rivet shank with a pneumatic punch or flame cut rivet head above the base metal using a rivet scarfing tip without damaging the base metal, and drive out shank using a pneumatic punch. If punching will damage the base metal, the shank shall be removed by drilling. Any damage to the base metal shall be repaired at no additional cost to the State.

All high strength bolts shall be the same diameter as the rivets they replace. High strength bolts shall be installed after the nicks, burrs and foreign substances that might interfere with seating of the bolt head and nut washers are removed. Light grinding may be required. Installation and inspection of high strength bolts shall be performed in accordance with the Steel Construction Manual.

If it becomes necessary to disconnect, or adjust, steel remaining as part of the structure to complete the work, the Contractor shall obtain the Engineer's approval prior to performing disconnections or adjustments. If the bolt will not fit the rivet hole, the hole may be reamed sufficiently to accommodate the bolt.

If the contract does not include an item(s) for cleaning, priming and painting of structural steel, cleaning and painting of the bolt and immediate surrounding area shall be done as part of this work. Cleaning and painting shall be done in accordance with the requirements of Section 574 *Structural Steel Painting: Localized*. All steel exposed by the cleaning operations shall be painted, including at least 2 inches in every direction from the washer's edge.

**586-3.03 Field Drill Holes in Existing Structural Steel.** If the steel is painted, prior to the beginning of any other work operations, the paint shall be removed for a minimum distance of 4 inches on each side

of the centerline of work location in accordance with the requirements of Section 574 *Structural Steel Painting: Localized*. Any required re-painting will be paid for separately.

The required hole diameter will be indicated on the contract documents. The Contractor shall not flame cut, or flame drill holes. All damage to existing steel caused by the contractor's operation, shall be repaired by the Contractor at no additional cost to the State.

**586-4 METHOD OF MEASUREMENT**

**586-4.01 Drilling and Grouting Anchors.** The quantity to be measured for payment will be the number of holes into which grout and bolts have been inserted.

**586-4.02 Removal of Rivets - Replacement with High Strength Bolts.** The quantity to be measured for payment will be the number of high strength bolts installed.

**586-4.03 Field Drill Holes in Existing Structural Steel.** The quantity to be measured for payment will be each hole drilled.

**586-5 BASIS OF PAYMENT**

**586-5.01 Drilling and Grouting Anchors.** The unit price bid for drilling and grouting anchors shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. The cost of new bolts and/or reinforcing bars will be paid for separately.

**586-5.02 Removal of Rivets - Replacement with High Strength Bolts.** The unit price bid for removal of rivets and replacement with high strength bolts shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work, including paint removal and painting. Payment will be made for each installed bolt regardless of whether a rivet was removed from the location.

**586-5.03 Field Drill Holes in Existing Steel.** The unit price bid for field drill holes in existing steel shall include the cost of all labor, equipment and materials necessary to satisfactorily complete the work, including paint removal when required. No additional payment will be made for holes drilled through different thicknesses, or through different numbers of plates.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
586.0201	Drilling and Grouting Bolts or Reinforcing Bars	Each
586.0202	Drilling and Grouting Bolts or Reinforcing Bars (with Non-Destructive Investigation)	Each
586.0301	Drilling and Grouting Bolts or Reinforcing Bars with Pullout Test	Each
586.0302	Drilling and Grouting Bolts or Reinforcing Bars with Pullout Test (with Non-Destructive Investigation)	Each
586.0401	Drilling and Grouting Bolts, Overhead or Sustained Tension, with Pullout Test	Each
586.0402	Drilling and Grouting Bolts, Overhead or Sustained Tension, with Pullout Test (with Non-Destructive Investigation)	Each
586.05	Removal of Rivets-Replacement with High Strength Bolts	Each
586.10	Field Drill Holes in Existing Structural Steel	Each

**SECTION 587 - BRIDGE RAILING RECONSTRUCTION**

**587-1 DESCRIPTION.** The work shall consist of the following:

- The removal and disposal of bridge railing.
- The Removal and storage of bridge railing.
- The installation of stored bridge railing.
- The furnishing and installing of box beam bridge railing.
- The furnishing and installing of thrie beam bridge railing.

**587-1.01 Bridge Railing Removed and Disposed; and Stored Bridge Railing Installed.** Material removed for disposal and material not used for installation shall become the property of the Contractor and shall be removed from the work site.

**587-1.02 Bridge Railing Removed and Stored.** All bridge railing removed shall remain the property of the State and shall be transported to a location within the project site designated by the Engineer.

## 587-2 MATERIALS

**587-2.01 New Material.** Materials shall meet the requirements of §710-23, Steel Bridge Railing and the following:

<b>Component</b>	<b>ASTM Designation or Standard Specification</b>
S3 x 5.7 Post	A36
Post Plate	A36
Spacer Brackets	A36
Rail Connection Angles	A36
Rail Plates	A36
“U” Bolts, Nuts and Washers	A307
Anchor Bolts, Nuts and Washers	F3125 GRADE A325
Thrie Beam	710-201
W6 x 25 Post	A36
Anchor Bolts (Thrie Beam)	A449
Carriage Bolts (Thrie Beam)	A307
Nuts and Washers for Carriage Bolts	A563 and F436
Attachment Plate	A36
Concrete Grouting Material	701-05

**NOTE:** 1. Thrie Beam Bridge Railing shall be fabricated from 10 gage material.

**587-2.02 Stored Material.** The Contractor shall choose the best available material for installation, subject to the approval of the Engineer.

## 587-3 CONSTRUCTION DETAILS

**587-3.01 Bridge Railing Removal.** If so indicated on the plans, the existing anchorages shall be reused for anchoring new or stored railing. Should this be the case, the Contractor shall exercise care removing the railing so as not to damage the existing anchorages. The provisions of §589-3.01 shall apply for the removal of any painted bridge railing.

**587-3.02 Bridge Railing Storage.** The Contractor shall remove, transport, unload and store bridge railing. Care shall be taken not to damage the railing during the various operations. In the event railing is damaged it shall be repaired or replaced in kind as directed by the Engineer. Such repair or replacement shall be done at no expense to the State.

**587-3.03 Stored Bridge Railing Installation.** Installation of the railing shall be done in accordance with the following subsections of section 568, Bridge Railing:

Inspection of Railing	568-3.01A1	Base Plates	568-3.01H
Field Welding	568-3.01D	Non-Metallic Pads	568-3.01I
Positioning Railing	568-3.01F	Anchor Studs	568-3.01L
Positioning Posts	568-3.01G	Inspection	568-3.01N

**NOTE:** 1. Bends or kinks in the railing which were present at the place of storage will not be cause for rejection.

**587-3.04 Box Beam Bridge Railing Installation.** Erection shall be in accordance with requirements of 568-3.01, Erection of Bridge Railing.

The installation procedure shall be coordinated to provide the least disturbance of pedestrian and vehicular traffic, if such traffic is maintained during the course of the work.

**587-3.05 Thrie Beam Installation**

**A. Direct Attachment to Existing Railing.** The railing shall be installed in accordance with the following:

Inspection of Railing	568-3.01A
Field Galvanizing for Repair	568-3.01C
Inspection of Galvanizing	568-3.01B
Inspection	568-3.01N

The railing shall be installed such that the bottom edge is parallel to the roadway profile.

**B. Separate Post Installation - Concrete Support Surface.** The posts and railing shall be installed in accordance with the following:

Inspection of Railing	568.3.01A
Positioning Posts	568-3.01G
Inspection of Galvanizing	568-3.01B
Base Plates	568-3.01H
Field Galvanizing for Repair	568-3.01C
Anchor Studs	568-3.01L
Field Welding	568-3.01D
Inspection	568-3.01N
Erection	568-3.01E

Mortar leveling courses shall be made from Concrete Grouting Material (§701-05). Manufacturer's instruction shall be strictly followed.

Railing shall be installed such that the bottom edge is parallel to the roadway profile.

**C. Separate Post Installation - Steel Support Surface.** The posts and railing shall be installed in accordance with the following:

Inspection of Railing	568-3.01A
Positioning Posts	568-3.01G
Inspection of Galvanizing	568-3.01B
Base Plates	568-3.01H
Field Galvanizing for Repair	568-3.01C

Anchor Studs	568-3.01L
Field Welding	568-3.01D
Inspection	568-3.01N
Erection	568-3.01E

Railing shall be installed such that the bottom edge is parallel to the roadway profile.

**587-4 METHOD OF MEASUREMENT**

**A. All Railing Removal and Installation Except Thrie Beam Railing Installation.** Measurement will be taken as the number of feet of railing removed, or installed. Measurement will be taken along the centerline of the top rail, end-to-end of railing between the limits indicated on the contract plans. No deduction will be made for open joints. If there is only one rail it will be considered the top rail.

**B. Thrie Beam Railing Installation.** Measurement will be taken as the number of feet of railing installed. Measurement will be taken along the top of the thrie beam, end-to-end of railing between the limits indicated on the contract plans. No additional measurement will be taken for overlapping sections of railing. If transition sections are installed, measurement will be taken to the end of the transition section indicated on the contract plans.

**587-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work. When required, mortar leveling courses, anchor bolts, nuts and washers shall be included in the unit price bid. The drilling and grouting of anchor bolts, when required will be paid for under a separate item.

Painting of the railing, if required, shall be paid under a separate item.

*Payment will be made under:*

Item No.	Item	Pay Unit
587.01	Bridge Railing Removal and Disposal	Foot
587.02	Bridge Railing Removal and Storage	Foot
587.03	Installation of Stored Bridge Railing	Foot
587.1001	Box Beam Bridge Rail, One Rail	Foot
587.1002	Box Beam Bridge Rail, Two Rail	Foot
587.20	Thrie Beam Bridge Rail - Attachment to Existing Bridge Rail	Foot
587.21	Thrie Beam Bridge Rail - New Post Installation Mounted on Concrete Surfaces	Foot
587.22	Thrie Beam Bridge Rail - New Post Installation Mounted on Steel Surfaces	Foot

**SECTION 588 - BRIDGE JOINT REHABILITATION**

**588-1 DESCRIPTION.** The work in this section shall include work required for bridge joint rehabilitation.

**588-2 MATERIALS.** Materials shall meet the requirements specified in the special specifications.

**588-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**588-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**588-5 BASIS OF PAYMENT.** As specified in the special specifications.



## SECTION 589 - REMOVAL OF STRUCTURAL STEEL

(Last Revised September, 2016)

**589-1 DESCRIPTION.** The work shall consist of removal and disposal of existing structural steel as shown in the contract documents and as directed by the Engineer.

**589-2 MATERIALS.** Not Specified.

### 589-3 CONSTRUCTION DETAILS

**589-3.01 General.** A minimum of 14 days prior to the removal of existing structural steel, the Contractor shall submit a written Structural Steel Removal plan meeting the requirements of §202-3.01A. *Demolition Plan* to the Engineer for approval. The Structural Steel Removal plan shall set forth all expected supports, disconnections and adjustments to steel which is to remain. If, during the course of the work it becomes necessary to support, disconnect, or adjust steel not previously noted in the Structural Steel Removal plan, the Contractor shall submit a revised plan to the Engineer for approval.

All work performed on steel which is to remain shall be in accordance with the applicable requirements of the Steel Construction Manual (SCM). Materials removed as part of this work shall become the property of the Contractor, and shall be removed from the work site.

Cutting of steel to remain shall be performed in a manner to produce edges and surfaces suitable for welding, in accordance with the requirements of the SCM, Part 603 *Surfaces and Edges to be Welded*. Thermal cutting of A709 steels shall be performed in accordance with the requirements of the SCM, Part 602 *Thermal Cutting of A709 Steels*. Replacement of steel removed will be paid for separately.

**589-3.02 Steel Structures Coated with Paint.** If the steel is coated with paint, prior to the start of steel removal operations, the paint shall be removed for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, rivet row, or weld, as applicable. The paint removal work shall be performed in accordance with the requirements of §202-3.01D. *Paint Removal*.

**589-3.03 Fastener Removals.** If rivet shanks, or bolts, cannot be removed by punching without damaging the base metal, the rivet shank, or bolt, shall be removed by drilling.

**A. Bolts.** Nuts shall be removed with wrenches, wherever possible, and the bolts driven out with a hand held punch. Alternate removal procedures shall be set forth in the Removal Plan.

**B. Rivets.** Rivets shall be removed by either of the following methods:

- Shearing the rivet head, using a pneumatic rivet breaker (helldog), and driving out the rivet shank with a pneumatic punch
- Flame-cutting the rivet head 1/16 inch above the base metal, using a rivet scarfing tip, and driving out the shank using a pneumatic punch.

**589-3.04 Welded Connection Disassembly.** Welded connections shall be disassembled in accordance with the following:

**A. Removal.** The affected weld shall be removed by means of air carbon arc gouging equipment. To avoid damaging the base material, 1/8 inch of weld material should be left in place. If more removal is needed to break the weld, then the removal shall be done in the vicinity of the component which will not remain. Any damaged steel to remain shall be repaired or replaced in a manner to be approved by the DCES.

**B. Grinding.** The weld material on the existing steel to remain in place shall be ground flush with the base metal surface. No base metal shall be removed by grinding.

**C. Inspection.** The Engineer will perform a visual inspection of all weld removal locations. If the Engineer suspects that damage has occurred, the Contractor shall perform a dye penetrant inspection in accordance with the requirements of the SCM.

If the Contractor's operations damage existing steel which is to remain in place, the damaged steel shall be repaired, or replaced, as determined by the DCES at no additional cost to the State.

**589-4 METHOD OF MEASUREMENT.**

The quantity to be measured for payment for removal of existing steel with a pay unit of pounds will be in pounds of existing steel removed, measured to the nearest whole pound. The weight of existing steel removed will be computed from the nominal sizes indicated in the contract documents. If the nominal size is not indicated, field measurements shall be used to determine the weight, using 490 pcf as the density of steel. The weight of bolts, rivets and welds will be neglected, and no deductions will be made for any rivet or bolt holes in the existing steel or for any section loss due to corrosion.

The quantity to be measured for payment for removal of existing steel with an each pay unit will be in each unit of existing steel removed.

**589-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including the removal of paint and fasteners, and disconnecting, supporting, or adjusting steel as necessary.

The treatment, handling and disposal of the paint removal waste will be paid separately.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
589.01nnnn	Removal of Existing Steel	Pound
589.52nnnn	Removal of Existing Steel	Each

NOTE: nnnn denotes a serialized pay item.

**SECTION 590 - ADJUSTMENT OF BRIDGE APPURTENANCES**

**590-1 DESCRIPTION.** This work shall consist of adjusting the elevation of bridge joints and drainage devices to meet the proposed finished elevations in the manner indicated on the Contract Plans.

In order to perform the work, it may be necessary to remove structural concrete. Structural concrete removal, if performed, shall be done under its respective item.

**590-2 MATERIALS.** Materials shall meet the following requirements:

Structural Steel	ASTM A36, A242 or A588
Nuts, Bolts, and Washers	ASTM A307 Grade A
Galvanized Coatings and Repair Methods	719-01
Preformed Elastic Joint Sealer	705-09

**590-3 CONSTRUCTION DETAILS.** All steel materials, including nuts, bolts, and washers, used as a part of this work, shall be galvanized in accordance with §719-01. Any galvanized surface, either existing or installed as a part of this work, which is damaged by welding or abrasion, shall be repaired in accordance with §719-01.

All welding shall be done in accordance with the applicable requirements of the New York State Steel Construction Manual.

The Contractor shall take suitable precautions to prevent damage to materials designated to remain-in-place. Damage to such material, due to the Contractor's operations, shall be repaired or the damaged material replaced, as determined by the Engineer.

Dimensions shown on the plans shall be verified by the Contractor and any necessary changes approved by the Engineer prior to construction of any needed fabrications.

Preformed elastic joint sealer, where required, shall be installed in accordance with the Contract Plans.

#### **590-4 METHOD OF MEASUREMENT**

**590-4.01 Bridge Drainage Devices.** The work will be measured as each bridge drainage device as defined by the Contract Plans which has had its elevation adjusted in accordance with the Contract Plans.

**590-4.02 Bridge Joints.** The work will be measured as the number of feet of joint system which has had its elevations adjusted in the manner indicated on the Contract Plans.

Measurement will be taken only between curb lines. No measurements will be taken across sidewalks, or raised medians. In the event that curbs are not present, measurement will be taken only to those points where the elevations have actually been adjusted.

#### **590-5 BASIS OF PAYMENT**

**590-5.01 Bridge Drainage Devices.** The unit price bid for each bridge drainage device adjusted shall include the cost of all labor, materials, and equipment necessary to complete the work.

No payment will be made for work done to repair damage due to the Contractor's operations, nor for any material supplied as replaced material made necessary due to damage attributable to the Contractor's operations.

**590-5.02 Bridge Joints.** The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work.

No payment will be made for work done to repair damage due to the Contractor's operations, nor for any material supplied as replacement material made necessary due to damage attributable to the Contractor's operations.

Any concrete removal or replacement will be paid for under the appropriate items.

#### ***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
590.01	Vertical Adjustment of Bridge Drainage Devices - 1	Each
590.02	Vertical Adjustment of Bridge Drainage Devices - 2	Each
590.03	Vertical Adjustment of Bridge Drainage Devices - 3	Each
590.04	Vertical Adjustment of Bridge Drainage Devices - 4	Each
590.05	Vertical Adjustment of Bridge Drainage Devices - 5	Each
590.21	Vertical Adjustment of Joint System - 1	Foot
590.22	Vertical Adjustment of Joint System - 2	Foot
590.23	Vertical Adjustment of Joint System - 3	Foot
590.24	Vertical Adjustment of Joint System - 4	Foot
590.25	Vertical Adjustment of Joint System - 5	Foot

#### **SECTIONS 591 THRU 593 (VACANT)**

#### **SECTION 594 - TIMBER AND LUMBER**

**594-1 DESCRIPTION.** Under this work the Contractor shall furnish and place timber and lumber of various sizes and types as may be specified for sills or platforms beneath the road, for culverts, bridges reinforcing existing structures, and for other similar purposes as shown on the plans or specified by the Engineer.

**594-2 MATERIALS.** Materials shall meet the following requirements:

Wood Preservative – Water Borne	708-31
Wood Preservative – Oil Borne	708-32
Timber and Lumber	712-13
Stress Graded Timber and Lumber	712-14
Steel Plates as Specified	715-01

**594-2.01 Fasteners.** Fasteners such as: spikes, nails, screws, timber connectors, bolts, nuts and washers shall meet the standard industrial fastener specifications for the intended application.

**594-2.02 Approval of Order.** Prior to ordering timber and lumber, the Contractor shall submit to the Engineer for approval, a detailed statement of his proposed order. No material shall be ordered until the statement is approved.

**594-2.03 Preservative Treatment.** The preservative treatment shall be applied to stress graded lumber and timber and shall conform to the requirements of the AWPA Standard U1-20, Commodity Specifications A (sawn products) and G (marine/saltwater applications).

**594-2.04 Sampling and Inspection.** Sampling and inspection will be done by an accredited representative of the Department. The Inspector shall have the power to take samples of the material for analysis and to reject those materials which do not fulfill the requirements of these specifications as to either quality or workmanship. The acceptance of any materials by the Inspector shall not be a bar to their subsequent rejection if found defective. The Contractor shall furnish all facilities and equipment for the inspection and testing of materials and workmanship and the Inspector shall be allowed free access to all premises where inspections can be made.

The Contractor shall give the Department and Department's Inspection Agents ample notice relative to the location of, and time when, treating operations will take place. Inspection of all timber and lumber will be made by the Department's Inspection Agents before, during, and after pressure treatment at the treating plant. No treated timber and lumber shall be shipped which does not bear, in legible form, the Inspector's stamp of approval.

### **594-3 CONSTRUCTION DETAILS**

**594-3.01 General.** Timber and lumber shall be placed or erected as shown on the plans or specified by the Engineer.

Any surface breaks resulting from storage and handling which do not warrant rejection shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied.

Paint, where specified, shall be applied as required by the Contract Documents.

**594-3.02 Treatment after Fabrication.** All cutting, framing and boring of timber and lumber shall be done before treatment whenever practicable. Cutting and boring below high water shall be particularly avoided in material which is to be used in waters infested with marine borers.

All cut surfaces and all bolt holes bored subsequent to treatment shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

All cut surfaces and bolt holes below the high water line shall, in addition to the AWWA M4 preservative treatment, be coated with a thick application of a mixture of 30% creosote and 70% pitch.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation.

**594-4 METHOD OF MEASUREMENT.** The quantity to be paid for timber and lumber will be the number of cubic feet placed in the completed work. In measuring dressed timber and lumber, the cross-section of any piece will be taken as the minimum nominal commercial size of undressed material from which the piece could have been cut. When round timber is used, it shall be estimated as square timber of the smallest undressed commercial size from which the timber can be manufactured. The length of any piece will be taken as the actual length in the finished work, making no deductions for bevels, notches or splices. If the measured quantity is first computed in board feet, the conversion factor shall be 0.083334 cubic feet per board feet.

**594-5 BASIS OF PAYMENT.** The unit price bid per cubic foot shall include the cost of furnishing all spikes, nails, screws, timber connectors, bolts, nuts, washers, hardware, preservative treatment and other required materials together with labor and equipment necessary to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
594.01	Timber and Lumber	Cubic Foot
594.02	Stress Graded Timber and Lumber	Cubic Foot
594.03	Treated Timber and Lumber	Cubic Foot

## **SECTION 595 - WATERPROOFING SYSTEMS FOR STRUCTURES**

**595-1 DESCRIPTION.** The work in this section shall include work required for waterproofing systems for structures.

**595-2 MATERIALS.** Materials shall be as specified in the special specifications.

**595-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**595-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**595-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 596 - OPEN STEEL FLOOR**

**596-1 DESCRIPTION.** The work shall consist of furnishing and placing open steel floor in structural slabs, at the locations indicated on the contract plans.

### **596-2 MATERIALS**

**596-2.01 Steel.** All steel for the component parts shall conform to the requirements of ASTM A36 or A588. If steel conforming to ASTM A36 is used, it shall be furnished with a minimum copper content of 0.20 percent.

The Contractor shall furnish the Department with two certified copies of the record of physical tests and chemical analysis of the steel used.

**596-2.02 Fabrication.** All the requirements and provisions of the SCM shall apply.

**596-2.03 Shop Painting.** The open steel floor shall be painted in accordance with the contract documents. Surfaces which are to be welded shall not be painted until all welding is completed.

**596-3 CONSTRUCTION DETAILS**

**596-3.01 Placement.** Open steel floor shall be placed true to line and grade and shall make full and even bearing on the underlying surface.

**596-3.02 Field Welding.** All the requirements and provisions of the SCM shall apply.

**596-3.03 Field Painting.** The requirements of §596-2.03 shop painting, shall apply.

**596-4 METHOD OF MEASUREMENT.** The quantity to be measured will be the actual area, in square feet, of open steel floor furnished and installed, including any portions that are filled with concrete.

**596-5 BASIS OF PAYMENT.** The unit price bid per square foot shall include the costs of all labor, material (including fabrication) and equipment necessary to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
596.01	Open Steel Floor	Square Foot

**SECTION 597 - TIMBER BRIDGE RAILING AND TRANSITIONS**

**597-1 DESCRIPTION.** The work shall consist of furnishing and erecting timber bridge railing and transitions as shown on the contract plans and in accordance with the specifications. As soon as the Contract is awarded, the Contractor shall notify the DCES of the name and address of the fabricator of all timber bridge railing. This notification shall list the specific shop or shops in which the railing will be fabricated.

**597-2 MATERIALS.** Materials for this work shall meet the following requirements:

<b>Component</b>	<b>ASTM or SAE Designation</b>
Internal Steel Plates	A36 (A709, Grade 36)
Rail Splice Plate	A36 (A709, Grade 36)
Tension Rods and Connection Bolts	F3125 GRADE A325 or A449 Type 1
Round Head Square Neck Threaded Bolt	A307 Grade A
Nuts	A563 Class 10S, Type HH
Washers	F436, Type 1
Thrie Beam	A588 or A572 (A709, Grade 36 or 36W)
Thrie Beam to W-Beam Transition Piece	A588 or A572 (A709, Grade 36 or 36W)
Dome Head Drive Spike	Industry Standard
Split Rings	SAE 1010 Hot Rolled Carbon Steel
Shear Plates	ASTM A47/A47M, Grade 32510

The provisions of §708-31 Wood Preservative - Water Borne, §708-32 Wood Preservative - Oil Borne, §712-14 Stress Graded Timber and Lumber, and §715-01 Structural Steel, shall apply.

Glued laminated timber shall comply with the requirements of the American Institute of Timber Construction (AITC). All wood products shall be pressure treated with wood preservative in accordance with §708-31 or §708-32 except that laminations for glue laminated timbers shall be treated prior to gluing with wood preservative designated as light pentain oil as in AWPA C28 and glued with wet-use adhesives conforming to Sections 4.5.1.2 of ANSI/AITC A190.1-1983.

The bridge rail shall be horizontally laminated glued laminated timber, visually graded Western species combination No. 2 or visually graded Southern Pine Combination No. 48. Other species and grades of glued laminated timber may be substituted provided that the minimum values tabulated in the latest edition of the National Design Specification for Wood Construction (ANSI/NFoPA NDS) are not less than the following:

$$F_{b \text{ y-y}} = 1800 \text{ psi}$$

$$E = 1800 \text{ ksi}$$

Posts, curbs, scuppers, and spacing blocks may be sawn lumber or glued laminated timber. When sawn lumber is used, material shall be visually graded No. 1 Southern Pine or visually graded No. 1 Douglas Fir-Larch. Other species and grades of lumber may be substituted provided that the minimum values tabulated in the latest edition of the National Design Specification for Wood Construction (ANSI/NFoPA NDS) or obtained through a Machine Stress Rated (MSR) procedure approved by the American Lumber Service (ALS) are not less than the following:

$$F_b = 1350 \text{ psi}$$

$$E = 1500 \text{ ksi}$$

### **597-3 CONSTRUCTION DETAILS**

**597-3.01 Fabrication.** Timber bridge railing shall be fabricated to the dimensions shown on the Contract plans and in compliance with the specifications.

**A. Shop Drawings.** Shop drawings shall be provided in accordance with the Steel Construction Manual (S.C.M.) except as follows:

- The drawings shall be submitted to the Engineer for review and approval; and
- The computed weights need not be shown.

**B. Galvanizing.** Galvanizing shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods, Type I. All steel components of the railing, including the round head square necked threaded bolts, shall be galvanized. Galvanizing of high-strength steel tension rods shall follow the recommendations of the tension rod manufacturer so as not to adversely affect the mechanical properties of the steel. All steel components shall be galvanized after welding and other fabrication.

Shop galvanizing repair of uncoated areas will be permitted on localized areas. Repair of localized areas is limited to a total of 2 square inches on any one component. Any component requiring more than 2 square inches of galvanizing repair shall be stripped and regalvanized.

Shop repair shall be in accordance with the methods given in §719-01.

The following areas shall not require galvanizing repair: One 1/8 inch maximum dimension spot of tight flux remaining in the fusion line of any 7 inch length of weld after blast cleaning, pickling and galvanizing.

**C. Shop Wood Repair.** All cutting, framing and boring of timber shall be done before treatment whenever practicable.

All cut surfaces shall be treated in accordance with AWP4 M4 with the addition that at least three coats of preservative shall be applied.

All bolt holes bored subsequent to treatment shall be treated with preservative by means of an approved pressure bolt hole treater. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

### **597-3.02 Erection of Timber Bridge Railing and Transitions**

**A. Inspection of Railing.** Prior to installation, all timber and lumber shall be examined for shakes, holes, knots, checks, splits, and decay. The Materials Requirements under "Defects" of §712-17 shall apply. Any piece of timber or lumber exhibiting any one of the aforementioned defects shall be subject to rejection as determined by the Engineer.

**B. Inspection of Galvanizing.** Immediately prior to erection, the railing shall be inspected for damage. Damage to the galvanizing of steel railing components shall constitute sufficient cause for rejection except for the following conditions:

1. If a damaged area is not required to be repaired under the provisions of §710-23, Steel Bridge Railing.
2. If the total damaged area of a single piece is 6 square inches or less. Total damaged area is exclusive of the damaged area described under §597-3.02B1.

**C. Field Wood Repair.** All cut surfaces shall be treated in accordance with AWP4 M4 with the addition that at least three coats of preservative shall be applied.

All bolt holes bored subsequent to treatment shall be treated with preservative by means of an approved pressure bolt hole treater. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation.

**D. Field Galvanizing Repair.** Field galvanizing repair shall be allowed to be performed upon damaged areas meeting the requirements of §597-3.02B2.

Field galvanizing repair shall be made by painting zinc repair material onto the damaged area in accordance with the requirements of §719-01, Galvanized Coatings and Repair Methods.

All finished surfaces of welds and adjacent surfaces where galvanizing has been removed, due to any field welding operation, shall be field galvanized.

**E. Holes in Metal Plates.** Prior to galvanizing, any necessary holes in the metal plates shall be made in the shop in accordance with the requirements of the S.C.M.

**F. Installation.** The installation work shall be done by bolting methods alone. The requirements of the S.C.M. shall apply.

**G. Posts.** Bridge railing posts shall be installed as truly vertical as possible within the following tolerance limit: 5/16 inch in any direction as measured from the top of the deck to the top of the post.

Bridge railing transition posts shall be installed at the location and in the manner indicated on the Contract plans. The Contractor shall carefully excavate for all post holes. Post holes and post foundation structures shall be backfilled and compacted in accordance with Section 203, *Select Structure Fill*.. Prior to acceptance, all posts shall be plumb to a tolerance of +/- 5/16 inch.



Posts, in their final position, shall satisfy the Material Requirements for "Defects" of §712-17.

The tops of all posts and the top of the rail splice plate kerf shall be sealed with roofing cement or otherwise protected from direct exposure to weather.

**H. Rails.** The rails of timber railings shall span a minimum of four (4) posts. Bolts on traffic face of rail shall be round head square neck threaded bolt. Railing splices shall be installed in the manner indicated on the Contract plans.

**I. Washers.** Unless otherwise noted, malleable iron washers shall be provided under bolt heads and under nuts that are in contact with wood. Washers may be omitted under heads of dome-head timber bolts when the size and strength of the head is sufficient to develop connection strength without wood crushing.

**J. Erection Inspection.** All erection shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

#### **597-4 METHOD OF MEASUREMENT**

**597-4.01 Timber Bridge Railing.** The quantity to be paid for timber bridge railing shall be the number of feet measured along the centerline of railing between the extreme outer limits indicated on the Contract plans.

**597-4.02 Timber Bridge Railing Transition.** The quantity to be paid for timber bridge railing transition shall be the number of transitions required.

**597-5 BASIS OF PAYMENT.** The unit price bid per linear foot of the timber railing shall include the cost of all labor, material and equipment necessary to do the work.

The price bid per timber bridge railing transition shall include the cost of all labor, material and equipment necessary to do the work.

All drilling and grouting work, if permitted, will be done at the contractor's expense.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
597.10	Timber Railing	Foot
597.20	Timber Railing Transition	Each

#### **598 AND 599 (VACANT)**



**Department of  
Transportation**

# **STANDARD SPECIFICATIONS**

(US CUSTOMARY UNITS)

**VOLUME 3  
SECTION 600**

**CONSTRUCTION  
AND  
MATERIALS**

**May 1, 2022**

50 Wolf Road  
Albany, New York 12232

[www.dot.ny.gov](http://www.dot.ny.gov)

## **INTRODUCTION**

This publication has been prepared to provide a compilation of standard requirements, called Specifications, used by the New York State Department of Transportation for construction contracts. These specifications are written to the Contractor. They define the Contractor's responsibility in meeting each specification, enumerate the Department's expectations and how they are going to measure and pay, and explain what the Contractor is expected to provide.

When this publication, entitled Standard Specifications (USC) and dated as shown on the Title Page, is incorporated by reference into the Department's construction contracts, it is made a part of that contract. The requirements stated herein may be revised or amended from time to time by notes or special specifications or documents of any description that would be furnished as part of a construction contract.

# STATE OF NEW YORK

## DEPARTMENT OF TRANSPORTATION

### ENGINEERING DIVISION

Contained herein are:

General Provisions of Contract;

Contract forms of Proposal, Agreement and Bonds;

General Construction Specifications;

Materials of Construction;

Payment Items

Adopted

by

The Commissioner of Transportation

and Short Titled

## **"STANDARD SPECIFICATIONS" (USC)**

*Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.*

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# Section 600

## INCIDENTAL CONSTRUCTION

### SECTION 601 - ARCHITECTURAL PAVEMENTS AND TREATMENTS (Last Revised September 2016)

**601-1 DESCRIPTION.** This work shall consist of the construction, placing, or applying of architectural pavements and treatments in accordance with the Contract Documents or as directed by the Engineer.

**601-2 MATERIALS.** Materials shall conform to the following subsections.

Bituminous Materials	702
Bituminous Tack Coat (SS-1h or CSS-1h)	702-3601
Fine Aggregates	703-01
Mineral Filler	703-08
Precast Concrete Street Pavers	704-23
Water	712-01

#### 601-2.01 Precast Concrete Street Paving.

**A. Neoprene-Modified Asphalt Adhesive.** Neoprene-Modified Asphalt Adhesive shall consist of 2% neoprene, grade WM1, oxidized asphalt with a R & B softening point of 154° F minimum and a penetration of 80, and 10% asbestos-free fibers.

**B. Polymeric Sand.** Polymer modified graded sand designed specifically for filling joints between pavers. Polymeric sand shall be supplied in clearly labeled sealed packages.

#### 601-3 CONSTRUCTION.

##### 601-3.01 Precast Concrete Street Paving

A. The provisions under §401-3, Construction Details for Plant Mix Pavements - General, shall apply.

B. The Contractor shall construct the subbase according to the current 601 Standard Sheet(s). Prior to placing the setting bed, the Contractor shall prepare the subbase surface according to §402-3.05a.

The bituminous setting bed shall consist of PG binder 64S-22 mixed with fine aggregate meeting the requirements of §703-01. Alternate PG binder grades may be allowed by the RME in lieu of PG 64S-22. The PG binder will meet the requirements outlined in Section 702 *Bituminous Materials*, Table 702-1 *Performance-Graded Binders for Paving*. The PG binder shall be 7.0% of the total batch weight. The mix shall be heated to approximately 325° F. The compacted thickness of the bituminous setting bed shall be  $\frac{3}{4}$  inch.

A coating of neoprene-modified asphalt adhesive shall be applied by mopping, squeegeeing or troweling over the top surface of the setting bed to provide bond under the bricks.

Precast concrete street pavers shall be laid in a 90° herringbone pattern according to the current 601 Standard Sheet(s) to provide a uniformly even surface, with no more than  $\frac{1}{4}$ " variation. Joints shall be  $\frac{1}{8}$  inch wide ( $\pm\frac{1}{16}$  inch). No precast concrete street pavers shall be laid when the air temperature is below 40° F. Joint lines shall not deviate more than  $\pm\frac{1}{2}$ " over 50 feet from string lines.



The Contractor shall fill gaps at the edges of the paved area with cut pavers or edge units. The Contractor shall adjust pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers subject to tire traffic shall be no less than one-third (1/3) of a whole unit. After pavers are placed on the adhesive, set them in it with at least one pass of a minimum 300 pound hand roller. Replace any cracked units with whole units and set them with the hand roller.

Polymeric sand shall be swept over the precast concrete street pavers until the joints are completely filled. The paver surface shall be swept clean and the joints lightly wetted with water. This joint filling operation shall not be performed if the air temperature is expected to fall below 40°F, or there is an expectation of rain within 4 hours of the completion.

**601-4 METHOD OF MEASUREMENT.** Architectural pavements and treatments will be measured by the number of square yards placed.

**601-5 BASIS OF PAYMENT.** The unit price bid per square yard shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material, except that any sawcutting of existing pavement, excavation, concrete base, curb, curb and gutter, and subbase course will be paid for separately.

*Payment will be made under:*

Item No.	Item	Pay Unit
601.01	Precast Concrete Street Paving (Bituminous Setting Bed)	Square Yard

**SECTION 602 - REHABILITATION OF CULVERT AND STORM DRAIN PIPE**  
(Last Revised January 2019)

**602-1 DESCRIPTION.** Rehabilitate culvert and storm drain pipe in accordance with these specifications, the contract documents, and as directed by the Engineer.

**602-2 MATERIAL REQUIREMENTS.**

**602-2.01 General.** Materials requirements are specified in the following subsections:

Portland Cement Concrete	501
Shotcrete	583
Concrete Repair Material	701-04
Vertical and Overhead Patching Material	701-08
Concrete Repair Material - High Early Strength	701-12
Grout Sand	703-04
Cured in Place Pipe (CIPP) Liner	706-09
Polyvinyl Chloride Pipe (relining)	706-10
(Profile Wall)	
(Corrugated)	
High Density Polyethylene Pipe (HDPE) (relining)	706-11
(Profile Wall)	
(Smooth Wall)	
Corrugated Steel Pipe	707-02
(Polymer Coated)	
Tunnel Liner Plate (relining)	707-05
Corrugated Structural Steel Plate for Pipe and Pipe Arches and Underpasses	707-09
Anchor Bolts for Corrugated Culverts	707-20
Zinc Chromate Primer	708-04
Bar Reinforcement, Grade 60	709-01

Wire Fabric for Concrete Reinforcement	709-02
Stud Shear Connectors	709-05
Membrane Curing Compound	711-05
Admixtures	711-08
Lightweight Concrete Fill (Type A or B)	733-01

**602-2.02 Grout for Annular Space.** Design the grout for the annular space between the existing pipe and new liner pipe in accordance with the pipe Manufacturer’s recommendations. Grout for the annular space shall be in accordance with 733-01 Lightweight Concrete Fill (Type B). Calculate the required volume of grout based on the existing culvert/storm drain internal diameter (minus deformations) and the external diameter of liner pipe. All grout components must appear on the Approved List unless approved by the Director, Materials Bureau.

**602-3 CONSTRUCTION DETAILS.** Provide the Engineer, a minimum of 10 days prior to starting of the work, a written proposal of how the work will be progressed. The proposal shall include dewatering of the pipe; procedures for maintaining line and grade of the lining pipe, pipe manufacturer’s recommendations for the assembly of preapproved joints, or joint fusion methods; bracing methods; grout mix design; and void filling techniques. Such proposals are also required, regardless of the rehabilitation method, for shotcreting, concrete, and void filling methods.

**602-3.01 Existing Pipe Preparation.** Dewater, clean and inspect the existing pipe. Determine the location of and remove obstructions that may prevent proper installation of the paving or lining material. Inspect small inaccessible pipes, generally less than 48 inches in diameter, using a closed circuit television and camera to provide a visual inspection. Provide strutting and bracing as required to ensure stability of the pipe.

**602-3.02 Handling & Installing Lining Materials**

**A. General.** Install each run of lining pipe with the same material for the entire run unless otherwise identified in the contract documents or approved by the Engineer. Do not allow water to flow along the invert during concrete or fill material placement.

**B. Structural Paving of Inverts with Concrete.** Apply §603-3.07 Concrete Paving for Corrugated Structural Plate Pipe with the exception of the following:

- Pave the area along the invert’s periphery, providing concrete cover thickness over the crests of the corrugations and concrete reinforcement details as indicated on the plans. If welding has been used to anchor the reinforcement or studs on a galvanized section of the pipe then upon completion of the anchoring, restore the coating in accordance with §702-02 Corrugated Steel Pipe, E. Coating Repair. Coating restoration is not required where mechanical anchoring of the reinforcement has been utilized.
- Use Class D, Class H or Class J concrete for paving of the invert.

**C. Lining with Shotcrete.** Apply all requirements of Section 583, Shotcrete with the exception of the following:

- Shotcrete may be used to line concrete pipe, stone arches, and corrugated metal pipes.

- All reinforcement design and details (e.g. spacing, anchoring, etc.) must be indicated on the plans. If welding has been used to anchor the reinforcement or studs on a galvanized section of the pipe then upon completion of the anchoring, restore the coating in accordance with §702-02 Corrugated Steel Pipe, E. Coating restoration is not required where mechanical anchoring of the reinforcement has been utilized.
- Apply a minimum 2 inch thick shotcrete layer over the crests of the corrugations. The shotcrete layer limits along the periphery will be indicated on the plans.

**D. Lining with Cured in Place Pipe (CIPP) Liner.** The CIPP manufacturer's / installer's name shall appear on the Department's Approved List of Materials and Equipment, Rehabilitation of Culverts and Storm Drains section.

The CIPP contractor shall provide the Engineer a report with design details and calculations for determining the minimum required thickness of the cured-in-place-pipe (CIPP) liner, the minimum internal pressure required to hold the wetted liner tight against the host pipe, and the maximum allowable internal pressure so as not to damage the wetted liner. All design calculations shall assume a fully deteriorated host pipe, unless Item 602.37xx, Lining Concrete pipe with Cured in Place Pipe (CIPP), is specified. All liner installations require the excavation of a resin containment pit to facilitate the installer's collection and subsequent disposal of any waste (styrene or non-styrene) and / or curing water from the jobsite. When the liner curing is completed, the installer will remove all waste prior to the lined pipe being put back in service. The plans will indicate the size of the excavation for the resin containment pit. The excavation, temporary storage of the fill and restoration of the downstream channel will be performed under Section 206-1.02, measured under 206-4.04 and paid under 206.0201 Trench, Culvert and Structure Excavation – O.G.

Use a resin / liner system meeting the following criteria:

- System consists of one or more layers of flexible needled felt or an equivalent material as approved by the Materials Bureau.
- Liner is flexible enough to fit irregular pipe sections and able to negotiate pipe bends.

Liner's surface must be coated with a plastic material compatible with the proposed resin. All liners containing styrene based resins require the use of a pre liner, to be inserted into the existing pipe before insertion of the CIPP liner. In addition to the pre liner, single or double sided liners may be specified in the contract plans, depending on the environmental setting of a particular application.

A thermoset resin and catalyst or an epoxy resin and hardener system, compatible with the proposed inversion system shall be used. If indicated in the contract documents, a resin containing less than five percent volatile organic compounds (VOCs) with less than 0.1 percent hazardous air pollutants (HAPs) and less than 0.1 percent of water quality pollutants as listed in 6 NYCRR Parts 700-705 shall be supplied. If the resin type (styrene or non-styrene) is not specified on the plans, the installer has the option to select the resin type. Proposed resin shall be compatible with the proposed inversion process.

Vacuum impregnate the liner with resin. Use a volume of resin capable of filling all voids in the liner material at nominal thickness and diameter. Adjust this resin volume by adding a minimum of 5% excess resin to allow for changes in resin volume due to polymerization and for any resin migration into the cracks and joints of the original pipe.

**1. Installation.** A cured-in-place-pipe (CIPP) liner may be installed into the host pipe by hydrostatic head, air pressure inversion, or a combination of the two. Do not exceed the manufacturer recommended maximum pressure to the liner felt fiber during the inversion process. Pulled in place installations may be allowed if it is indicated on the contract documents or if the installer is given prior approval by the Director, Materials Bureau.

- a. **Hydrostatic Head.** The standpipe height must be sufficient to maintain at least the minimum required pressure between the CIPP liner and the existing (host) pipe. The lower end of the liner must extend beyond the outlet end whenever possible. Where changes in elevation may create excessive stresses on the liner felt, the use of bulkheads may be necessary. Alternative installation methods using a hydrostatic head will be subject to approval by the Director, Materials Bureau.
- b. **Air Pressure.** The liner may be inverted using air pressure to extend it to the termination point. The air pressure needs to be adjusted and sustained to a level capable of holding the liner against the host pipe regardless of the curing method proposed to be used.

**2. Curing.** Cure the liner by circulating heated water throughout the section. Uniformly raise the temperature of the water above the level required to cure the resin. Monitor and record both the temperature of the curing water exiting the heating source and the temperature of the curing water returning to the heating source. Monitor and record the observed temperatures by the remote sensors on the liner-host pipe interfaces, located in the upstream and downstream area of the pipe. The remote temperature sensors readings will be used for monitoring the progress of curing and its duration. The minimum curing time is the sum of the minimum recommended initial and post-curing times as per the liner resin supplier's recommendations. The onset of the initial curing approximately occurs when all remote temperature sensors register a temperature consistent with the "exotherm", which shall be included in the Manufacturer's recommendations. Post-cure the liner at least for the minimum post-curing time *and at the minimum post-curing temperature level*, as per the liner Manufacturer's recommendations. Add post-curing time for any deviations from the recommended post-curing temperature levels. All resin Manufacturers' curing proposals require approval by the Director of Materials Bureau prior to its initial use by the Department. Also, a new curing proposal submission for approval is required if an already approved liner Manufacturer introduces a new resin formulation and/or a new liner curing method to a Department contract.

**3. Water and Material Management.** After post-curing is completed, manage the curing water so that it does not cause or contribute to a violation of water quality standards to receiving waters or groundwater 6 NYCRR Part 700-704. In particular, the CIPP Contractor shall note the surface water quality and groundwater standards at 6 NYCRR Part 703 for pollutants such as styrene and thermal discharges. The CIPP Contractor shall enquire as to the classification of potential receiving surface waters in the project location if this information is not provided in the contract documents.

- A. Handling of curing water used in a styrene based thermoset resin liner installation:
  1. Collect and transport curing water from the site for reuse within another CIPP location; and/or
  2. Collect the water and dispose or treat at off site facilities. Transport wastewaters within vehicles that have a waste transporter permit 6NYCRR 364. Off-site disposal shall be at a publicly owned treatment works or at a disposal facility permitted to accept the wastewater. The Contractor shall conduct off site treatment to reduce styrene concentrations to acceptable levels to meet water quality standards prior to discharge to the receiving waters; and/or
  3. Treat wastewater on-site to acceptable styrene and thermal loading and discharge to receiving waters in accordance with agreements received from the Regional NYSDEC Office.

- B. For curing water from non-styrene based processes, collect water for disposal off-site as described in A1 and A2 above or discharge on site if it does not contain pollutants that could cause or contribute to a violation of water quality standards. Reduce temperature to prevent a violation of the thermal standards to the receiving waters.
- C. Collect any excess resin and any curing materials at the upstream and downstream ends of the installation for disposal.
- D. Record and document quantities of curing water removed from the site. Provide record/documentation of the reuse and/or disposal facility and quantity disposed of curing water leaving the site.

After post-curing is completed, cool the liner to a temperature of 100° F prior to relieving the static head in the inversion standpipe. Cool-down may be accomplished by adding cool water into the inversion standpipe to replace warm curing water being removed from the liner. Contract documents may contain restrictions on the temperature of the released curing water or whether the curing water needs to be removed and treated. Any other proposed liner curing methods will be subject to the approval of the Director, Materials Bureau.

**4. Workmanship / Damage / Defects.** The finished pipe liner shall be continuous over the entire length of an inversion run and be free of dry spots, lifts and delaminations. If any dry spots, lifts and delaminations exist, remove the liner in those areas. Mark a line 3 feet from both ends of the distressed area, cut the distressed area out, and replace it at no cost to the Department. If the Cured-In Place-Pipe (CIPP) liner does not fit against its termination point, seal the space between the pipe and liner with a resin mixture compatible with the CIPP. The liner may be sampled and tested for tensile and flexural properties in accordance with ASTM F 1216 at the discretion of the Department. Failure to meet the designed properties will be a cause for liner rejection.

**5. Storm Drain Lateral Connections.** Reconnect the existing storm drain lateral connections after the liner has been cured in place. Use robotic cutting devices to reestablish tie-ins in non-man accessible pipes.

**E. Lining with a new Liner Pipe-General.** Before lining, pull or push a single piece of liner pipe through the existing pipe to verify liner clearance. The liner must be positioned and secured to facilitate its complete encapsulation by grout.

Follow the Manufacturer's recommendations for handling and assembling the pipe and all provisions included in the approved written proposal.

When required, reconnect existing storm drain lateral connections by utilizing an open cut excavation, internal connection or remote installation using robotics. Prior to filling the annular space, connect and seal all laterals between the new liner pipe and the existing lateral.

Grout the entire annular space. Provide a minimum annular space of 1 inch for grouting between the new and existing pipes. Provide details on how to hold the liner pipe to line and grade until the grout has set.

If the volume of the grout used is less than the anticipated (calculated) volume, or an inspection of the relined culvert indicates that there are voids in the annular space, the Contractor must provide the EIC with a plan to rehabilitate all identified voids. Depending on the location and size of the voids, additional grouting may be required in these areas. This may be accomplished by re-grouting in those areas from within the culvert. The voids must be filled to the satisfaction of the Engineer at no additional cost to the state. Grout that fills invert and connected voids is covered in the cost for these items.

**1. Lining with High Density Polyethylene Pipe.** Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

Reline with Smooth Wall Polyethylene Pipe or Profile Wall Polyethylene Pipe, as indicated in the contract documents.

Install all pipe, fittings, adapters and appurtenances according to the Manufacturer's recommendations. Limit joint separations to less than ½ inch between adjoining sections. Field cuts will be permitted only at the terminal ends. No HDPE pipe sections less than 3 feet long will be allowed in any lining projects.

Perform all butt fusion, welding and extrusion welding of HDPE pipe in accordance with the Manufacturer's recommendation. A Manufacturer's representative – or an individual trained by the manufacturer – must be present at all times during any fusion or welding operations. Alternate joining methods will be subject to approval by the Director, Materials Bureau.

**2. Lining with Polyvinyl Chloride Pipe.** Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

Reline with a Profile Wall PVC Pipe or Corrugated Wall PVC Pipe with integral bell and spigot joints.

The installation proposal for this item to be submitted by the contractor for Departmental approval should in addition address the following PVC specific issues prior to any work approval is granted; Whether the PVC liner will be pulled or pushed through the culvert and the type of pushing or pulling ring/plate to be used; Whether a nose cone or a different device will be used in this process and how the jacking, pulling or pushing loads on the liner will be monitored in order to conform to the PVC liner's Manufacturer's specifications and guidelines. Include PVC liner's Manufacturer's specifications and guidelines in the submitted for approval proposal. Follow all Manufacturer's recommendations during joint assembly operations.

**3. Lining with Corrugated Metal Pipe.** Reline with Polymer Coated Corrugated Steel Pipe.

Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

Insert and brace the liner pipe to the specified line and grade, and align adjacent pipe sections such that port holes, if used, are placed as detailed in the contract plans (Alignment bolts are not adequate bracing by themselves). Sever all alignment bolts not fully turned out and grind them flush to the new pipe interior. If port holes are used, provide fittings and plugs compatible with the delivery equipment. Insert the plugs into the fittings as the operation is completed. Limit joint separations to ½ inch between adjoining sections. To ensure that grout remains in the annular space, place internal expanding joint bands with annular corrugations and foam gaskets at each joint. Before grouting the annular space, brace and strut the bands. Do not obstruct with any bracing material the flow of grout into the annular space. Remove the bracing, struts and bands upon completion of this work.

**4. Lining with Corrugated Steel Structural Plate Pipe and Pipe Arches with PCC Paved Invert.** Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe – General.

Align adjacent pipe sections such that port holes, if used, are placed as detailed in the contract plans. If port holes are used, provide port hole fittings and plugs compatible with the delivery equipment. Insert the plugs into the fittings as the grouting operation is completed. Alignment bolts are not adequate bracing by themselves. Sever all alignment bolts not fully turned out and grind them flush to the new pipe interior. Do not obstruct with any bracing material the flow of grout into the annular space. Once lining with this item has been completed, apply §603-3.07 Concrete Paving for Corrugated Structural Plate Pipe and as indicated in the contract documents.

**5. Lining with Steel Tunnel Liner Plate.** Prior to lining, follow in its entirety all provisions of §602-3.02 E. Lining with a new Liner Pipe - General.

Line with tunnel liner plates (double flange). Use a lap type longitudinal seam. Fabricate the lap to allow a continuous cross section of the plates through the seam. Use an offset depth equal to the metal thickness for the full width of plate, including flanges. Drilling, punching or drifting to correct defects in manufacturing will not be permitted. Plates with improperly punched holes will be rejected.

Use 5 bolts per 18 inch width of plate in each lapped longitudinal joint and stagger the bolts in the ridges and valleys. Follow the Manufacturer’s recommendation for circumferential and longitudinal bolt spacing.

**602-3.03 Damaged Pipe and Repair.** Repair all damage to the existing host pipe caused that is strictly obstructing the progress of the relining operation. Repair any damage to the newly installed liner caused during construction, consistent with recommendations of Section 603- 3.04 Damaged Pipe and Repair.

**602-4 METHOD OF MEASUREMENT**

**602-4.01 Lining with new pipe.** This work will be measured as the number of feet along the bottom centerline, measured to the nearest foot.

**602-4.02 Paving inverts.** This work shall be measured as the number of square feet determined by the paved width measured along the pipes interior circumference at the top of the corrugations and the length along the centerline of the pipe measured to the nearest square foot.

**602-4.03 Shotcreting.** This work shall be measured as the number of square feet determined by the shotcreted width measured along the pipes interior circumference at the top of the corrugations and the length along the centerline of the pipe measured to the nearest square foot.

**602-5 BASIS OF PAYMENT.** Include the cost of furnishing all labor, materials, and equipment necessary to complete the work in the unit price bid. Include the cost of all fill material needed to fill the annular space between the existing pipe and the liner pipe, dewatering and cleaning of existing pipe, and the removal of any obstructions, intrusions or damaged pipe prior to lining.

For Paving Inverts and Shotcreting, include the cost of furnishing all labor, materials and equipment necessary to complete the work for the unit price bid and include all necessary preparations such as dewatering and cleaning to the existing pipe.

For Cured in Place Pipe, include the cost of furnishing all labor, materials and equipment necessary to complete the work for the price unit bid and include all necessary preparations such as dewatering and cleaning to the existing pipe, all activities involving water treatment as well as water and waste transportation and disposal. The excavation for the resin containment pit, temporary storage of the fill and restoration of the downstream channel will be paid for under *206.04 Trench and Culvert Excavation – O.G.*

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
602.2002	Structural Paving of Inverts with Portland Cement Concrete	Square Feet
602.2101	Lining Culvert with Shotcrete	Square Feet
602.25xx	Lining with High Density Polyethylene Pipe	Feet
602.26xx	Lining with Smooth Wall High Density Polyethylene Pipe	Feet
602.27xx	Lining with Profile Wall High Density Polyethylene Pipe	Feet
602.30xx	Lining with Polyvinyl Chloride Pipe	Feet
602.36xx	Lining with Cured in Place Pipe (CIPP)	Feet

602.37xx	Lining Concrete pipe with Cured in Place Pipe (CIPP)	Feet
602.51xxxx	Lining with Corrugated Steel Structural Plate Pipe with PCC Paved invert	Feet
602.53xxxx	Lining with Corrugated Steel Structural Plate Pipe Arch with PCC Paved invert	Feet
602.550101	Lining with Steel Tunnel Liner Plate 10ga	Square Feet
602.550102	Lining with Steel Tunnel Liner Plate 8ga	Square Feet
602.550103	Lining with Steel Tunnel Liner Plate 7ga	Square Feet
602.550104	Lining with Steel Tunnel Liner Plate 5ga	Square Feet
602.550105	Lining with Steel Tunnel Liner Plate 3ga	Square Feet
602.75xx	Lining with Polymer Coated CSP 12ga, (2- 2/3"x1/2")	Feet
602.80xx	Lining with Polymer Coated CSP 12ga, (3"x1") or (5"x1")	Feet

Refer to Contract Proposal for full Item Number and full description.

## SECTION 603 - CULVERTS AND STORM DRAINS

**603-1 DESCRIPTION.** Construct culverts and storm drains in accordance with these specifications, the contract plans, and the appropriate standard sheets.

### 603-2 MATERIALS

**603-2.01 General.** Materials requirements are specified in the following subsections:

Geotextile	207	Corrugated Structural Steel Plate for Pipe,	
Portland Cement Concrete	501	Pipe-Arches and Underpasses	707-09
Portland Cement	701-01	Galvanized Steel End Sections	707-10
Masonry Cement	701-02	Aluminum End Sections	707-11
Concrete Repair Material	701-04	Corrugated Aluminum Pipe	707-13
Concrete Repair Material – High Early Strength	701-12	Corrugated Aluminum Structural Plate for Pipe and Pipe-Arches	707-14
Mortar Sand	703-03	Anchor Bolts for Corrugated Culverts	707-20
Non-Reinforced Concrete Pipe	706-01	Zinc Chromate Primer	708-04
Reinforced Concrete Pipe	706-02	Bar Reinforcement, Grade 60	709-01
Reinforced Concrete Elliptical Pipe	706-03	Wire Fabric for Concrete Reinforcement	709-02
Reinforced Concrete End Sections	706-07	Plastic Coated Fiber Blankets (For Curing)	711-03
Polypropylene Pipe	706-08		
Smooth Interior Corrugated Polyethylene Pipe	706-12	Membrane Curing Compound	711-05
Corrugated Steel Pipe	707-02	Water	712-01
Ductile Iron Pipe (Non-Pressure)	707-03	Galvanized Coatings and Repair Methods	719-01

### 603-3 CONSTRUCTION DETAILS

**603-3.01 Excavation.** Apply the requirements specified in Section 206, Trench, Culvert and Structure Excavation, except as modified by the Contract Documents or as directed by the Engineer.

#### 603-3.02 Laying Pipe

**A. General.** Lay all pipe in close conformity to line and grade having a full, firm and even bearing at each joint and along the entire length of pipe. Lay all pipe beginning at the downstream end and



progress upstream. Use the same material in each run of pipe unless otherwise directed by the Engineer.

**B. Handling and Assembly of Pipe.** Follow the Manufacturer's instructions or approved Materials Details except as modified on the Contract Plans or as directed by the Engineer.

**C. Bell and Spigot Type Pipe.** Lay all pipe with the bells upstream. Where the spigot end of an existing pipe does not fit the bell end of a new pipe, construct a concrete collar as shown on the Standard Sheets. Fill the bottom half of the space on the inside of the pipe between the existing spigot and the new bell with an approved concrete repair material (§701-04 or §701-12). Alternate designs may be submitted to the Director, Materials Bureau, for approval.

Where the spigot end fits into the bell end and the clearance is so great as to render the elastomeric gasket or preformed sealer ineffective, join the pipe by caulking a gasket of jute or oakum into the joint space and then fill with mortar of equal parts of Portland Cement and Mortar Sand or a preformed or poured caulking compound of a type approved by the Engineer.

**D. Round Corrugated Metal Pipe and Pipe-Arches.** Place steel or aluminum pipe with longitudinal seams located at the sides. Place circumferential seams with laps in the downstream direction so flow of water is directed over instead of under each succeeding downstream section.

**E. Corrugated Structural Plate Pipe and Pipe-Arches.** Assemble the plates for corrugated steel or aluminum structural plate pipe and pipe-arches to form the circular pipe or pipe-arch cross section as defined by the pipe manufacturer.

For metal pipe arches, install the bolts nearest the visible edge of the lapped joint in the valley at the top of the corner plate of the corrugations. Cover the joint with the top of the corner plate on the outside of the structure with a geotextile conforming to Geotextile Underdrain from the Department's Materials Bureau Approved List. Extend the covering a minimum of 12 inches beyond each side of the joint for its entire length. A minimum of 12 inches is required for any longitudinal lap.

**F. Polyethylene and Polypropylene Pipe.** Handle, store and assemble all pipe in accordance with the Approved Materials Details except as modified in the Contract Documents or by the Engineer. Joint misalignment resulting in offsets greater than 1/4 inch or joint separations greater than 1/2 between adjoining sections of pipe will not be allowed. Field cuts are permitted only at the terminal ends and with a minimum pipe length of 40 inches.

**G. Corrugated Metal End Sections.** Assemble all pipe end sections in accordance with the Contract Documents or as approved by the Engineer.

**H. Thickness Measuring Equipment.** Prior to laying any pipe, provide the Engineer with equipment to measure gauge and steel coating thickness. Gauge shall be measured with a micrometer caliper. Measure steel coating thickness with a Type II Fixed Probe Magnetic Gauge meeting the requirements of Steel Structures Painting Council Specification SSPC-PA2. When the Engineer verifies the required gauge and coating thickness the pipe may be laid. Micrometer calipers and Type II probes shall remain the property of the Contractor.

**603-3.03 Bedding and Backfilling Pipe.** Apply the standards of Section 203, *Select Granular Fill* and the appropriate NYSDOT Standard Sheets. Select Granular Fill used to backfill around aluminum or aluminum coated pipes will be free of portland cement unless the pipe sections are thoroughly coated with Zinc Chromate Primer, §708-04 or an equivalent alternative as approved by the Materials Bureau. 100% of the Select Granular Fill used around Type IR and IIR corrugated aluminum pipe must pass a 2 inch sieve.

### **603-3.04 Damaged Pipe and Repair**

**A. General.** Repair, realign or replace pipe that is damaged or disturbed through any cause occurring prior to acceptance of the contract. Pipe which is defective, and determined by the Engineer as unrepairable, will be unacceptable for installation and shall be replaced as directed by the Engineer at no cost to the State.

**B. Concrete Pipe.** Repair concrete pipe in accordance with the requirements set forth in §706-02 Reinforced Concrete Pipe. The repairs will be acceptable if they are sound, properly finished and cured, as determined by the Engineer, and the repaired pipe conforms to the requirements of the Contract Documents.

**C. Damaged Bituminous Coating and Paving.** Damage to bituminous coating shall be repaired with asphalt repair material. The repair material shall appear on the Department's Approved List. Damage to bituminous paving shall be repaired by an application of the original hot material for areas 2 square feet or less in each pipe section. Damage to bituminous paving in areas greater than 2 square feet in a pipe section will be cause for rejection of that section.

**D. Polyethylene and Polypropylene Pipe.** Polyethylene pipe with damaged ends may be incorporated into the work at terminal locations provided the damaged portion is totally removed by the field cut. Repair or replacement of pipe that is disturbed, damaged or misaligned must provide the same product as a new pipe installation, as determined by the Engineer. After backfilling operations are complete, inspect the pipe for deflection. No more than 5% deflection of the internal diameter will be allowed. If this is exceeded, the pipe will be rejected and removed at the Contractors expense.

**603-3.05 Field Strutting of Corrugated and Structural Plate Pipe.** Field strutting of corrugated metal pipe and structural plate pipe may be done at the Contractor's option and expense to provide added protection from construction equipment and other loads during installation, backfilling and filling above the pipe. The method and scheduling of installation and removal of strutting, must be approved by the Engineer. Field strutting shall constitute installation of structurally sound timber sills, compression caps and struts.

### **603-3.06 Joints**

**A. Corrugated Metal Pipe.** Use corrugated band field connections for corrugated metal pipe and pipe arch connections. Lap the band on equal portions of each culvert section to be connected. All connections shall be an approved type, fabricated and installed so that a secure and firm pipe connection may be readily made in the field. Thoroughly coat all aluminum or aluminum coated field connections in contact with concrete with Zinc Chromate Primer §708-04 or an equivalent alternative as approved by the Materials Bureau and permit to dry prior to concrete placement.

**B. Structural Plate Pipe.** Assemble plates for structural plate pipe and pipe arches with joints staggered such that not more than three (3) plates come together at any one point. Tighten all nuts for field or shop assembled plates to at least 150 but not more than 300 ft-lbs of torque, before filling and backfilling are commenced. Supply the Engineer-in-Charge with an approved torque wrench.

**C. Concrete Pipe.** For round concrete pipe, use flexible water-tight elastomeric gaskets. For elliptical pipe and cattle pass use concrete pipe joint sealing compound meeting the requirements of §705-16. Install all sealants at the time the pipe is being laid to line and grade.

To detect leakage in the finished installation, internal pressure tests will be required in concrete pipe only when specified in the Contract Documents. If a leakage test is required, use an exfiltration test between consecutive manholes. Perform the test by filling the pipe with water to a height 24 inches above the top of the pipe at the upstream manhole and allowing the pipe to remain saturated for a period of 72 hours prior to checking for leakage. No more than 250 gallons per inch of pipe diameter per mile in a 24 hour period will be allowed.

Where a culvert or a storm drain system is open at either one or both ends, with or without end sections, use a minimum of 90 inches. Round pipe less than 24 inches in diameter, elliptical pipe, and larger diameter round pipe beginning with 66 inch diameter where the weight of the pipe section requires a shorter length shall have a minimum length of 72 inch.

Shorter sections will be permitted where they are required to obtain an exact length of culvert. Use of shorter sections requires approval by the Engineer. For closed storm drain systems, drains having structures such as drop inlets on each end, the length of sections is unspecified.

Connect the first three full sections at the open end(s) of a culvert or storm drain system together to restrain movement of the sections. A full section is defined as a section with a minimum laying length of 90 or 72 inches as defined in the preceding paragraph. An end section is considered as the first section. If a short section is used at the end or within the first three full sections of a culvert, connect it together with the first three full sections.

Use a device at the springline on each side of the pipe to restrain the sections from movement. Use a device at least 12 feet in length when using 90 inch minimum length pipe sections and at least 120 inches in length when used with 72 inch minimum length sections. Securely anchor the devices to the pipe, with minimum slack in the device and the joints. Locate anchoring points a minimum of 18 inches from the end of the pipe sections and the flared end sections. Anchor each end of the device with a 1 inch diameter bolt with a nut and washer, or its equivalent, through the section wall. Apply ANSI B 18.2.1, ANSI B 18.2.2 and ANSI B 27.2, Grade A or B respectively for all nuts, bolts, and washers. For all round pipe 48 inches in diameter and smaller, and/or equivalent diameter elliptical pipe use a steel strap for the restraining device conforming to ASTM A36 with a minimum width of 2 1/4 inches, 1/4 inch minimum thickness with 1 1/4 inch maximum diameter holes centered 1 1/2 inch from each end. For pipe larger than 48 inches in diameter and for cattle pass, the requirements for the restraining devices will be shown on the contract plans. Apply the requirements of §719-01, Galvanized Coatings and Repair Methods: Type I for straps and Type II for nuts, bolts, and washers for the steel strap and anchoring hardware.

Alternative designs of the restraining device and anchoring hardware will be considered for approval by the Director of the Materials Bureau if they provide equivalent restraining properties and durability.

Restraining devices may be placed on either the inside or outside of the pipe. If placed on the inside, the device shall not protrude from the wall to the degree where flow would be obstructed. Only cold bending of the restraining device is allowed. Holes in the pipe and end sections required for the anchor bolts may be drilled in the field.

***D. Ductile Iron Pipes.*** Form joints by caulking a gasket of jute or oakum into the hubs and then filling with mortar consisting of equal parts of Portland Cement Type I or Type II, Mortar Sand, or at the Contractor's option, a preformed or poured caulking compound of a type approved by the Engineer. For sanitary sewer systems, apply the joint requirements of ASTM C425.

***E. Polyethylene and Polypropylene Pipe Connections.*** Manufactured ends shall be used for joint assemblies; no field cuts are permitted unless approved by the Engineer. No separations greater than 1/2 inch are permitted between adjoining sections of pipe. Use only appropriate fittings for lateral connections supplied by the pipe manufacturer and shown on the standard sheet, except that the pipe shall protrude 2 inches into the basin to provide a 45° battered grout seal. Apply the battered grout seal to both the interior and exterior faces of the basin.

**F. Dissimilar Metal Pipe Connections.** Use a sleeve gasket when joining corrugated pipe or end sections to pipes or end sections fabricated of dissimilar metals between the pipe(s) and the coupling band. Keep the ends apart, to prevent electrical contact between the dissimilar metals. Apply the requirements of ASTM A36/A36M for all gaskets.

**G. Breaking into Existing Drainage Structures.** When breaking into existing drainage structures to make a pipe connection, remove only the minimum amount of material from the wall of the structure. After inserting the pipe, fill the cavity between the pipe exterior and the wall of the drainage structure in accordance with the drainage structure Standard Sheets. Large spaces may be chinked with 704-13 Precast Concrete Driveway and Sidewalk Pavers.

**H. Tolerance.** A 1/2 inch difference in diameter is allowed when joining round pipes or the spans or rises of pipe-arches. A 1 1/2 inch difference is allowed in the perimeters. These tolerances may be attained by proper production control or by match-marking pipe ends.

**603-3.07 Concrete Paving for Corrugated Structural Plate Pipe.** Place reinforced Portland Cement Concrete over the inverts of corrugated structural plate pipe where specified and indicated on the Contract Documents, so as to form a smooth interior. Do not place pavement until the embankment has been completed over the pipe and settlement has been completed to the satisfaction of the Engineer.

Pave the bottom 25 percent of the inside circumference for round pipe, the bottom 30 percent of the inside periphery for arch spans of 10 feet 3 inches and shorter and the bottom 35 percent of the inside periphery for arch spans longer than 10 feet 3 inches unless otherwise specified by the Engineer. A minimum cover of 4 inches is required over all corrugations. Schedule and conduct the diversion of water operations prior to and during the placement of pavement in a manner satisfactory to the Engineer. Prior to placing pavement clean and dry the surfaces to be in contact with concrete to the satisfaction of the Engineer.

Place the steel fabric reinforcement on the crests of corrugations and securely fasten to the pipe or pipe-arch by welding or by other methods acceptable to the Engineer. Place the reinforcement to provide a 4 inch minimum clearance from the edges of concrete and lap 6 inch minimum. Unless otherwise shown on the plans, the steel fabric reinforcement shall consist of No. 6 gauge wire at 6 inch centers transversely and longitudinally.

Finish the pavement to a smooth surface acceptable to the Engineer. Within 18 hours after completion of finishing, protect the surface by either an approved curing cover or an approved membrane curing compound applied at a minimum rate of 1 gallon per 150 square feet. However, any concrete in the invert that would be exposed to sunlight must be cured immediately after the finishing operations have been completed and the surface water has evaporated.

Cure the concrete for a minimum period of 48 hours before water is permitted to flow on the invert. If the atmospheric temperature is below 45°F, the requirements of 555-3.08C, Provisions for Concreting in Cold Weather, shall apply.

**603-3.08 Relaying Pipe.** Carefully remove, clean, preserve, haul and relay pipe as directed by the Engineer or as called for in the Contract Documents. The relaid pipe shall be true to line and grade, and have a full, firm, even bearing and be comparable to newly laid pipe. Construct joints of relayed pipe as specified in §603-3.06. When existing pipe is damaged during removal or relaying, rendering it unfunctional, replace it with new pipe at no additional cost to the State. Existing pipe which is determined by the Engineer to be unfit for relaying may be destroyed before removal.

Apply the requirements of §603-3.03 for backfill and placement.

**603-3.09 Anchor Bolts.** Unless instructed otherwise, use anchor bolts, as specified in §707-20 to anchor the ends of corrugated metal pipes, and sectional plate arches to either reinforced or plain concrete headwalls.

**603-3.10 Culvert-End Safety Grates.** Culvert-end safety grates shall be fabricated in accordance with the Standard Sheets.

The grate shall lay flat on the embankment slope, overlap the opening equally on each side, and at the top as indicated in the contract documents. The Contractor shall perform any necessary excavation, backfill, and final slope shaping and grading to ensure proper grate support and smooth uniform slopes in the area surrounding the grate. All disturbed areas will be reestablished to the satisfaction of the Engineer.

#### **603-4 METHOD OF MEASUREMENT**

**603-4.01 Pipe.** The Engineer will measure the pipe, in feet along the bottom centerline, furnished and incorporated into the work in accordance with the Contract Documents.

**603-4.02 End Sections.** The Engineer will count the number of units of each size or diameter furnished and incorporated into the work in accordance with the Contract Documents.

**603-4.03 Relaying Pipe.** The Engineer will measure the existing pipe relayed and any new pipe laid and furnished to replace existing pipe, in feet along the bottom centerline, incorporated into the work in accordance with the Contract Documents.

**603-4.04 Concrete Collars.** The Engineer will count the number of concrete collars furnished and incorporated into the work in accordance with the Contract Documents.

**603-4.05 Culvert-End Safety Grates.** Culvert-end safety grates will be measured in square feet to the nearest 0.1 square foot of safety-grate installed, using payment areas shown on the Standard Sheet. For sizes that are not shown on the Standard Sheet, the area will be computed as the product of the overall length and width.

#### **603-5 BASIS OF PAYMENT**

**603-5.01 General.** The accepted quantities of all pipe construction and reconstruction will be paid for at the contract price bid which will include the cost of furnishing all labor, materials and equipment necessary to complete the work including those joints made with oakum, portland cement and mortar or poured caulking compounds.

For concrete end sections include the cost of the restraining devices and their installation. If no end sections are specified and restraining devices are required, include the cost of the restraining devices in the unit price bid for the pipe. Include the cost of bituminous coating or concrete paving including steel wire fabric reinforcement, when specified in the unit price bid for the respective pipe items. Include the cost of breaking into existing drainage structures to connect new pipe in the unit bid price for the respective pipe items. Include the cost of anchor bolts, when required, in the unit bid price for pipe items.

Progress payment may be made to the extent of 80% of the price bid for pipe items requiring concrete invert paving when the installation is substantially completed and backfilled to a minimum of 24 inch over the top of the pipe plus whatever additional cover is necessary to protect the installation from construction traffic. The remaining 20% will be paid upon completion of the invert paving.

Excavation, granular fill and backfill will be paid for separately under their appropriate items in Sections 203 and 206, as applicable except include the additional costs necessary for the special gradation

for Backfill Material for Corrugated Aluminum Pipe-Type IR and the additional cost necessary to assure the backfill material be free of portland cement in the unit bid price for these pipes.

Include the cost of adding water for compaction in the price bid, unless items for furnishing water equipment and applying water are included in the proposal.

Payment for the geotextile material and its installation is included under the structural pipe arch item.

**603-5.02 End Sections.** Include the cost of all labor, materials and equipment necessary to complete the work as specified in the contract documents. The cost of the restraining devices and their installation, required for concrete pipe, shall be included in the unit price bid for the end sections.

**603-5.03 Concrete Collars.** Include the cost of all labor, materials (including concrete repair material) and equipment necessary to complete the work as specified in the contract documents.

**603-5.04 Culvert-End Safety Grates.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including excavation, topsoil, seeding and mulching.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
603.0101	Culvert-End Safety Grate	Square Foot
603.0102	Culvert-End Safety Grate (Heavy-Duty)	Square Foot
603.02xx	Non-Reinforced Concrete Pipe	Foot
603.05xxxx	Corrugated Steel Pipe (2 2/3 x 1/2)	Foot
603.06xxxx	Corrugated Steel Pipe Paved Invert (2 2/3 x 1/2)	Foot
603.07xxxx	Corrugated Steel Pipe Fully Paved (2 2/3 x 1/2)	Foot
603.08xxxx	Corrugated Steel Pipe Arch (2 2/3 x 1/2)	Foot
603.09xxxx	Corrugated Steel Pipe Arch, Paved Invert (2 2/3 x 1/2)	Foot
603.10xxxx	Corrugated Steel Pipe Arch, Fully Paved (2 2/3 x 1/2)	Foot
603.11xxxx	Corrugated Steel Pipe (3 x 1) or (5 x 1)	Foot
603.12xxxx	Corrugated Steel Pipe Paved Invert (3 x 1) or (5 x 1)	Foot
603.13xxxx	Corrugated Steel Pipe Fully Paved (3 x 1) or (5 x 1)	Foot
603.14xxxx	Corrugated Steel Pipe Arch (3 x 1) or (5 x 1)	Foot
603.15xxxx	Corrugated Steel Pipe Arch Paved Invert (3 x 1) or (5 x 1)	Foot
603.17xxxx	Galvanized Steel End Sections Pipe (2 2/3 x 1/2)	Each
603.18xxxx	Galvanized Steel End Sections Pipe Arch (2 2/3 x 1/2)	Each
603.20xxxx	Galvanized Steel End Sections Pipe Arch (3 x 1) or (5 x 1)	Each
603.23xx	Corrugated Structural Steel Plate Pipe (60 - 108 Diam.)	Foot
603.24xx	Corrugated Structural Steel Plate Pipe (114 - 162 Diam.)	Foot
603.25xx	Corrugated Structural Steel Plate Pipe (168 - 216 Diam.)	Foot
603.26xx	Corrugated Structural Steel Plate Pipe (222- 252 Diam.)	Foot
603.27xx	Corrugated Structural Steel Plate Pipe PCC Paved Invert (60 - 108 Diam.)	Foot
603.28xx	Corrugated Structural Steel Plate Pipe PCC Paved Invert (114 - 162 Diam.)	Foot
603.29xx	Corrugated Structural Steel Plate Pipe PCC Paved Invert (168 - 216 Diam.)	Foot
603.30xx	Corrugated Structural Steel Plate Pipe PCC Paved Invert (222 - 252 Diam.)	Foot
603.31xx	Corrugated Structural Steel Plate Pipe Arch (6 feet 1 inch - 20 feet 7 inch span, 9PI, Corner Plate)	Foot
603.32xx	Corrugated Structural Steel Plate Pipe Arch, PCC Paved Invert (6 feet 1 inch - 19 feet 8 inch span, 9PI, Corner Plate)	Foot
603.35xx	Corrugated Structural Steel Plate Underpass	Foot
603.40xxxx	Round Corrugated Aluminum Pipe (2 2/3 x 1/2) (12 - 30 Diam.)	Foot
603.41xxxx	Round Corrugated Aluminum Pipe (3 x 1) (36 - 96 Diam.)	Foot
603.44xxxx	Corrugated Aluminum Structural Plate Pipe (9 x 2 1/2)(60 - 114 Diam.)	Foot

603.46xxxx	Corrugated Aluminum Structural Plate Pipe (9 x 2 1/2)(120- 180 Diam.)	Foot
603.48xxxx	Corrugated Aluminum Pipe-Arch (2 2/3 x 1/2)(17 Span, 13 Rise) to (57 Span, 38 Rise), and (3 x 1) (60 span, 46 Rise to 95 Span, 67 Rise)	Foot
603.50xxxx	Corrugated Aluminum Structural Plate Pipe-Arch (9 x 2 1/2) (6 ft 1 in Span, 5 ft Rise to 11 ft 5 in Span, 7 ft Rise)	Foot
603.52xxxx	Corrugated Aluminum Structural Plate Pipe-Arch (9 x 2 1/2) (12 feet 3 inch Span, 7 feet 3 inch Rise to 19 feet 5 inch Span, 11 feet 11 inch Rise)	Foot
603.53xxxx	Corrugated Aluminum Pipe, Type IIR	Foot
603.54xxxx	Corrugated Aluminum End Sections Pipe	Each
603.55xxxx	Corrugated Aluminum End Sections, Pipe Arch	Each
603.56xxxx	Corrugated Steel Pipe- Type IR	Foot
603.58xxxx	Corrugated Aluminum Pipe- Type IR	Foot
603.59xxxx	Corrugated Steel Pipe- Type IIR	Foot
603.60xx	Reinforced Concrete Pipe Class III	Foot
603.61xx	Reinforced Concrete Pipe Class IV	Foot
603.62xx	Reinforced Concrete Pipe Class V	Foot
603.66xx	Reinforced Concrete Horizontal Elliptical Pipe Class HE II	Foot
603.67xx	Reinforced Concrete Horizontal Elliptical Pipe, Class HE III	Foot
603.68xx	Reinforced Concrete Horizontal Elliptical Pipe, Class HE IV	Foot
603.69xx	Reinforced Concrete Vertical Elliptical Pipe, Class VE IV	Foot
603.70xx	Reinforced Concrete Vertical Elliptical Pipe, Class VE V	Foot
603.71xx	Reinforced Concrete Vertical Elliptical Pipe, Class VE VI	Foot
603.72xx	Reinforced Concrete Cattle Pass	Foot
603.73xx	Reinforced Concrete Pipe End Sections	Each
603.74xx	Reinforced Concrete Pipe Class II	Foot
603.77	Concrete Collars	Each
603.7802xx	Polypropylene Pipe (Optional) -Type S, or Type D	Foot
xx= 12, 15, 18, 24, 30, 36, 42, 48, 60	(denoting pipe diameter in inches)	
603.80xxxx	Corrugated Steel Pipe-Polymer Coated (2 2/3 x 1/2)	Foot
603.81xxxx	Corrugated Steel Pipe-Polymer Coated Paved Invert (2 2/3 x 1/2)	Foot
603.82xxxx	Corrugated Steel Pipe-Arch Polymer Coated (2 2/3 x 1/2)	Foot
603.83xxxx	Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (2 2/3 x 1/2)	Foot
603.84xxxx	Corrugated Steel Pipe-Polymer Coated (3x1) or (5x1)	Foot
603.85xxxx	Corrugated Steel Pipe-Polymer Coated Paved Invert (3x1) or (5x1)	Foot
603.86xxxx	Corrugated Steel Pipe-Arch Polymer Coated (3x1) or (5x1)	Foot
603.87xxxx	Corrugated Steel Pipe-Arch Polymer Coated Paved Invert (3x1) or (5x1)	Foot
603.88xxxx	Corrugated Steel Pipe-Aluminum Coated (Type II) (2 2/3 x 1/2)	Foot
603.89xxxx	Corrugated Steel Pipe-Arch Aluminum Coated(Type II)(2 2/3 x 1/2)	Foot
603.90xxxx	Corrugated Steel Pipe-Aluminum Coated (Type II)(3x1) or (5x1)	Foot
603.91xxxx	Corrugated Steel Pipe-Arch Aluminum Coated(Type II)(3x1) or (5x1)	Foot
603.92xxxx	Corrugated Steel Pipe-Aluminum Coated (Type 2) Type IR	Foot
603.93xxxx	Corrugated Steel Pipe-Arch Aluminum Coated (Type 2) Type IIR	Foot
603.95xx	Ductile Iron Pipe	Foot
603.96xxxx	Smooth Lined Corrugated Aluminum Pipe (2 2/3 x 1/2)	Foot
603.97xxxx	Smooth Lined Corrugated Aluminum Pipe (3 x 1)	Foot
603.98xx	Smooth Interior Corrugated Polyethylene Culvert and Storm Drain Pipe	Foot
603.99	Relaying Pipe	Foot

Refer to Standard Contract Pay Item Catalog for full Item Number and full Description. Numbers in parentheses (without denotation) are spacing and depth of corrugations in inches.

## SECTION 604 - DRAINAGE STRUCTURES

### 604-1 DESCRIPTION

**604-1.01 General.** This work shall consist of the construction or alteration of drainage structures, manholes, leaching basins and transverse drainage interceptors in accordance with these specifications, the contract plans and the standard sheets.

**604-1.02 Adjustment Rings and Frames for Drainage Structures and Manholes.** The Contractor shall furnish and install prefabricated adjustment rings and frames for drainage structures and manholes. The extensions shall elevate and support drainage structure grates or manhole covers without the necessity of removing the original drainage structure frame or manhole casting, when the roadway is resurfaced.

### 604-2 MATERIALS

**604-2.01 Drainage Structures and Manholes.** Materials used for the construction of drainage structures and manholes shall be as indicated on the plans, and/or Standard Sheets, and shall conform to the requirements of the following:

Cast-in-Place Concrete - Class A	501
Frames and Grates	655
Concrete Repair Material	701-04
Concrete Grouting Material	701-05
Concrete Repair Material - High Early Strength	701-12
Precast Concrete Driveway and Sidewalk Pavers.	704-13
Premolded Resilient Joint Filler	705-07
Masonry Mortar	705-21
Reinforced Concrete Pipe	706 02
Precast Concrete Drainage Units	706-04
Bar Reinforcement, Grade 60	709-01
Wire Fabric for Concrete Reinforcement	709-02
Cold Drawn Wire for Concrete Reinforcement	709-09
Steps for Manholes	725-02

**604-2.02 Transverse Drainage Interceptors.** Materials used for the construction of transverse drainage interceptors shall meet the requirements of §604-2.01, except that bar reinforcement shall meet the requirements of §709-04, Epoxy Coated Bar Reinforcement, Grade 60.

Transverse drainage interceptors, if precast, shall meet the requirements of §706-04, Precast Concrete Drainage Units.

Dowels shall be fabricated from epoxy coated bar reinforcement conforming to §709-04.

**604-2.03 Leaching Basins.** Materials used for the construction of leaching basins shall conform to the requirements of §604-2.01 and shall be as indicated on the plans. Concrete for precast units shall conform to the requirements of §706-04, Precast Concrete Drainage Units.



**604-2.04 Adjustment Rings and Frames for Drainage Structures and Manholes.** Materials for prefabricated adjustment rings and frames for drainage structures and manholes shall conform to the following:

Prefabricated Adjustment Rings & Frames for Drainage Units & Manholes

715-13

**604-2.05 Altering Drainage Structures, Leaching Basins and Manholes.** Materials for the repair and alteration of existing structures shall meet the requirements of §604-2.01 and shall be as indicated on the contract plans. Structures originally constructed with concrete block, common brick or concrete brick shall be altered with Precast Concrete Driveway and Sidewalk Pavers, §704-13, unless indicated otherwise on the contract plans.

### **604-3 CONSTRUCTION DETAILS**

**604-3.01 Excavation.** Excavation shall be in conformance with the Construction Details of §206-3 Trench, Culvert and Structure Excavation.

**604-3.02 Concrete Drainage Structures and Manholes.** Concrete drainage structures and manholes shall be constructed in accordance with the requirements of these specifications, the Standard Sheets and plans. The Contractor shall have the option of erecting either cast-in-place or precast drainage structures unless specified otherwise. Cast-in-place drainage structures shall be constructed of Class A concrete and to the requirements of Section 555 Structural Concrete.

The Contractor shall have the option of constructing either a rectangular or circular drainage structure when such option is specified and allowed in the contract documents. When the circular structure is selected, it shall conform to the requirements of §706-04 and will require submission of complete working drawings to the Engineer for review and approval.

Contractor proposed changes to drainage structures shown on the Standard Sheets or on the plans, other than minor changes approved by the Engineer, shall require submission of complete working drawings to the Engineer for review and approval.

Unless prohibited in the contract documents, the Contractor shall have the option of reducing the size of the drainage structure riser above the uppermost pipe entry in accordance with the requirements of the Standard Sheets. Flat slab reducer designs proposed by the Contractor shall be subject to the review and approval of the Engineer and shall be accompanied by the following:

1. Working drawings prepared by a Professional Engineer licensed to practice in New York State.
2. The design calculations used in the preparation of the working drawings.

Acceptance of flat slab tops or platforms for flat slab reducer designs will be on the Basis of Proof-of-Design Test or on the Basis of Rational Design as required by ASTM C478.

**604-3.03 Masonry Construction.** Masonry construction, when indicated on the plans or standard sheets, shall consist of concrete pavers laid in full mortar beds. All joints shall be full mortar joints not greater than 1/2 inch wide. When specified, the outside of the masonry construction shall be plastered with 1/2 inch thick mortar coat.

**604-3.04 Leaching Basins.** Leaching basins shall be constructed in accordance with these specifications and the contract plans.

**604-3.05 Pipe Entries.** All pipe(s) built into the wall(s) of a drainage structure shall be flush with the inside face of the drainage structure wall and shall project outside a sufficient distance to allow connection with the adjoining section. The wall knockouts and sealing the space around the pipe shall be

in accordance with the Standard Sheets. The bell of concrete pipe shall be cut off at every pipe entry where the bell enters the drainage structure.

**604-3.06 Steps.** Drainage structures steps may be cast or bolted in place during construction, mortared with a concrete grouting material after the structure is completed or attached by friction locking into preformed or drilled holes. The steps shall clear all pipes. Steps in risers and conical top sections shall be aligned to form a continuous ladder with rungs equally spaced vertically in the completed structure at a maximum distance of 16 inches. Steps shall be embedded into the walls of the riser or conical top section a minimum of 3 inches. The rung shall project a minimum clear distance of 4 inches from the walls of the riser or conical sections measured from the point of embedment.

**604-3.07 Frames and Grates.** Frames and grates shall be as specified in the contract documents. Frames located in the top slab or top of the uppermost riser shall be secured and held in place by a minimum of 4 stirrups or studs per frame, welded to the frame near the corners. Parallel bar frames shall contain shear stud anchors, for the purpose of transferring loads, as required and detailed on the standard sheet for parallel bar grates and frames. Shear stud anchors, when required, shall replace the frame securing stirrups or studs.

**604-3.08 Altering Drainage Structures, Leaching Basins and Manholes.** Reconstruction and adjustment of existing drainage structures shall be as detailed and specified on the contract plans. Construction with cast-in-place concrete shall conform to the requirements of Section 555, Structural Concrete.

Frames, grates and covers to be reused shall be removed, cleaned and reset at the required elevations. New frames, grates and manhole covers shall be installed when specified. Upon completion, each structure shall be cleaned of any accumulation of silt, debris or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

**604-3.09 Adjustment Rings and Frames for Drainage Structures and Manholes.** Prior to the placement of the surface course and after the placement of the binder course, when required, the Contractor shall install adjustment rings and frames for manholes and drainage units. The adjustment ring or frame shall be placed so the manhole cover or drainage unit grate will not protrude above the finished surface of the pavement.

To assure a firm and secure fit with the adjustment ring or frame, the seat of the existing manhole casting or drainage unit frame shall be free of all foreign material at the time of installation. The entire assembly shall be set on the seat of the existing manhole casting or drainage unit frame and the locking devices shall be tightened evenly. The manhole cover or drainage unit grate shall then be set upon the seat of the adjustment ring or frame.

The Contractor shall be responsible for insuring that the adjustment rings and frames are compatible with the existing manhole castings and covers or drainage frames and grates.

All rings or frames shall be protected from displacement caused by traffic maintained on the roadway or equipment used in the paving operation.

The Contractor shall have the option of removing and resetting the existing manhole casting or drainage unit frames to the required grade where shown on the plans or approved by the Engineer.

**604-3.10 Transverse Drainage Interceptors.** This work shall consist of the construction of reinforced concrete transverse drainage interceptors with frames and grates, and dowels as shown on the plans or Standard Sheets. Unless specifically designated on the plans and/or in the proposal, the Contractor shall have the option of constructing cast-in-place or precast transverse drainage interceptors.

**A. Cast-in-Place.** Cast-in-place transverse drainage interceptors shall conform to the requirements of Section 555 Structural Concrete. The cast-in-place interceptors shall be constructed so that they have

construction joints at a maximum spacing of 24 feet, unless the Engineer gives written directions otherwise or a longer length is specified on the plans.

**B. Precast Interceptors.** Precast interceptors shall be laid in reasonably close conformity to line and grade and shall have a full, firm and even bearing at each joint and along their entire length.

They shall be handled and assembled in accordance with the manufacturer's instructions, except as modified on the plans or by the Engineer's written directions. Six (6) ¼ inch thick Premolded Resilient Joint Filler shall be placed in the joint between the units, and the lifting hole and dowels shall be grouted with material conforming to §701-04, §701-05 or §701-12. Underdrain and Underdrain Filter shall be installed when shown on the plans or directed by the Engineer.

The underdrain pipe shall be installed in accordance with §605-3.01, and the underdrain filter shall be placed in accordance with §605-3.02 except when the details of either or both are modified on the plans or by the Engineer's written order.

**604-3.11 Backfill.** No structure shall be backfilled until all the mortar has completely set. The requirements of Section 203, *Select Granular Fill*, shall apply.

#### **604-4 METHOD OF MEASUREMENT**

**604-4.01 Drainage Structures, Leaching Basins and Manholes.** Drainage structures, leaching basins and manholes will be measured for payment by the number of linear feet of height measured to the nearest tenth of a foot from the bottom of the base to the top of the masonry, including the top slab.

#### **604-4.02 Transverse Drainage Interceptors**

**A. Cast-In-Place.** Cast-in-place transverse drainage interceptors will be measured by the actual length of interceptor placed.

**B. Precast.** Precast transverse drainage interceptors will be measured by multiplying the number of whole units by the nominal length of each unit and adding thereto the length of any fractional units incorporated in the work. The nominal length of the units shall be indicated on the Standard Sheet.

**604-4.03 Altering Drainage Structures, Leaching Basins and Manholes.** Altering drainage structures, leaching basins and manholes will be measured by the number of structures altered.

**604-4.04 Adjustment Rings and Frames for Drainage Structures and Manholes.** This work will be measured by the number of prefabricated adjustment rings or frames furnished and installed.

#### **604-5 BASIS OF PAYMENT**

**604-5.01 Drainage Structures, Leaching Basins and Manholes.** The unit price bid per linear foot shall include the cost of all labor, equipment and materials, including bar reinforcement and welded wire fabric, necessary to complete the work, except the following:

**A. Excavation .** Excavation will be paid for under Trench and Culvert Excavation.

**B. Backfill.** Backfill of drainage structures and leaching basins will be paid for under the item(s) shown in the contract documents.

**C. Frames, Covers and Grates.** Frames, covers and grates will be paid for under the appropriate payment items for Frames and Grates in Section 655.

**604-5.02 Contractor Options.** When the specifications allow the Contractor to substitute a precast circular drainage unit in lieu of a rectangular drainage unit or the Contractor constructs a flat slab reducer design under the provisions of §604-3.02, the following basis of payment provisions will apply.

1. §604-5.01 will apply.
2. Payment for excavation and backfill will be for those quantities determined for the original structure.
3. No adjustments will be made to the unit price bid for the original structure.

**604-5.03 Altering Drainage Structures, Leaching Basins and Manholes.** The unit price bid for each shall include the cost of all materials, labor and equipment necessary to satisfactorily complete the work including all necessary cleaning, excavation, backfill, and replacement of any pavement, shoulder and sidewalk courses, subcourses, curbs, drives, lawns and any other surface. Frames, covers or grates to be reused that are broken by the Contractor's operations shall be replaced at the Contractor's expense. New frames, covers and grates will be paid for under the appropriate payment items for Frames and Grates in Section 655.

**604-5.04 Adjustment Rings and Frames for Drainage Structures and Manholes.** The unit price bid for each adjustment ring or frame shall include the cost of all material, labor and equipment necessary to satisfactorily install the adjustment rings and frames. If the Contractor elects to reset the existing casting or frames, the costs of the work involved in the removal and replacement of existing disturbed pavement shall be included in the price bid for the adjustment rings and frames.

**604-5.05 Transverse Drainage Interceptors.** The price per linear foot bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except the excavation will be paid for under Trench and Culvert Excavation, and the Underdrain and Underdrain Filter will be paid for under their respective items.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
604.01	Leaching Basin	Foot
604.06	Transverse Drainage Interceptors	Foot
604.07XXYY	Altering Drainage Structures, Leaching Basins and Manholes XX = Region (01 through 11) YY = Serialized 01 to 99 *	Each
604.10	Prefabricated Adjustment Rings for Manholes	Each
604.11	Prefabricated Adjustment Frames for Drainage Structures	Each
604.30XXYY	Rectangular Drainage Structure XX = Structure Type ** YY = Frame No. **	Foot
604.31XXYY	Rectangular Drainage Structure with Round Option XX = Structure Type ** YY = Frame No. **	Foot
604.32XXYY	Rectangular Drainage Structure with Concrete Cap XX = Structure Type ** YY = Frame No. **	Foot
604.40XX	Round Precast Manhole XX = Type **	Foot
604.50XXYY	Special Drainage Structure	Foot

XX = Region (01 through 11)

YY = Serialized 01 to 99 \*

\* Serialized number identified structure detailed on the plans.

\*\* Structure type and frame number are as defined on the Drainage Structure Details Standard Sheets and the Grate and Frame Standard Sheets.

## SECTION 605 - UNDERDRAINS

**605-1 DESCRIPTION.** The work shall consist of constructing underdrain installations in accordance with these specifications and in conformity with the lines, grades, and cross-sections shown in the contract documents.

### 605-2 MATERIALS

**605-2.01 Underdrain Pipe.** Underdrain pipe shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing* for the type of pipe specified in the contract documents:

Corrugated Steel Pipe - Type III, 16 gage	707-02
Porous Concrete Pipe Underdrain	706-05
Extra Strength Porous Concrete Pipe Underdrain	706-05
Perforated Corrugated Polyethylene Underdrain Tubing	706-13
Corrugated Aluminum Pipe - Type III, 16 gage	707-13
Perforated Polyvinyl Chloride Underdrain Pipe	706-18

Optional underdrain pipe shall meet the requirements of any of the above at the Contractors option except that porous concrete pipe shall not be used in an edge of pavement underdrain installation.

**605-2.02 Underdrain Filter.** The requirements for Underdrain Filter materials are described below. The procedure for acceptance or rejection of Underdrain Filter materials shall be in conformance with the procedures contained in the geotechnical control procedure "*Procedure for the Control and Quality Assurance of Granular Materials*". Underdrain Filter material shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing* for the type of underdrain filter material specified in the contract documents:

**A. Underdrain Filter Type I.** Provide material meeting the requirements of §733-20 *Underdrain Filter, Type 1*.

**B. Underdrain Filter Type II.** Provide material meeting the requirements of §733-20 *Underdrain Filter, Type 2*.

**C. Underdrain Filter Type III.** Provide material meeting the requirements of §733-20 *Underdrain Filter, Type 3*.

### 605-3 CONSTRUCTION DETAILS

**605-3.01 Underdrain Pipe.** The construction details of Section 603 *Culverts and Storm Drains* shall apply. The type of filter material to be used at any location will be as shown in the contract documents. A carefully leveled and compacted bed of this material shall be prepared just prior to the placement of the underdrain pipe. The upgrade end of corrugated polyethylene underdrain pipe shall be closed with a solid plastic cap; the upgrade end of all other types of underdrain pipe shall be closed with a suitable plug. Unless otherwise shown in the contract documents, the underdrain pipe shall be placed with the

perforations down. In the event that the semi-circular option of the Steel Pipe underdrain is utilized, the pipe shall be placed such that the flat surface is on the top.

***A. Perforated Corrugated Polyethylene Underdrain Tubing and Perforated Polyvinyl Chloride (PVC) Underdrain Pipe.***

When these underdrains are daylighted through the side slope they shall be protected from sunlight by shielding with a minimum 3 ft. long section of corrugated steel or aluminum pipe at the outlet. The metal pipe for shielding the underdrain shall be of such internal diameter to easily slip over the underdrain. For 4 in. and 6 in. diameter underdrains, the metal pipe shielding the underdrain shall extend a minimum of 6 in. into the ground and overlap the underdrain by 6 in. For underdrains from 8 in. through 12 in. in diameter, the metal shielding pipe shall extend at least 12 in. into the ground and overlap the underdrain by 12 in. In no case shall the outlet end of the underdrain be exposed or extend beyond the end of the metal pipe shielding it. To prevent intrusion of the filter material into the joint between the metal and underdrains, a reducer fitting shall be placed over the joint, roofing felt shall be wrapped around the joint, or another method shall be approved by the Engineer.

Perforated corrugated polyethylene underdrain tubing and perforated PVC underdrain pipe will melt and burn when exposed to flame. Flame damage or damage by deterioration, crushing or stretching will be cause for rejection.

***B. Corrugated Aluminum Pipe.*** Do not place grout in contact with aluminum pipe, such as at drainage inlet structures, including connections, fixtures, etc., unless the aluminum has been thoroughly coated with Zinc Chromate Primer, §708-04 *Zinc Chromate Primer* or an equivalent alternative as approved by the Materials Bureau.

***C. Optional Underdrain Pipe.*** The Contractor shall not intermix types of underdrain in the same run of pipe.

**605-3.02 Underdrain Filter.** After the pipe installation has been inspected and approved, Underdrain Filter shall be loosely placed around and over the pipe to such a depth that, after compaction, Underdrain Filter shall extend to a level 6 in. above the underdrain pipe or to the next course, whichever is less. Subsequent lifts of Underdrain Filter shall be no more than 6 in. thick prior to compaction and shall be compacted by two passes of a vibrating pad or drum type compactor. The remainder of the installation shall be in accordance with the applicable standard sheet or as indicated in the contract documents.

If the excavation for the underdrain extends outside the payment lines, it shall be backfilled with Underdrain Filter material installed at the Contractor's expense.

Any contaminated underdrain filter material shall be replaced by the Contractor at no additional cost to the State.

For corrugated polyethylene underdrain tubing, the filter material shall be placed around and over the tubing to such a depth that, after compaction, the underdrain filter material shall extend to a level 12 in. above the underdrain tubing or to the next course, whichever is less. After placement, the surface of the filter material shall be compacted by three passes of a vibrating pad or drum type compactor. The remainder of the backfill shall be placed in maximum 2 ft. loose lift thicknesses and compacted by three passes of a vibrating pad or drum type compactor after the placement of each lift.

In the event that a pipe is not included in this installation, the filter shall be placed in horizontal layers not exceeding 6 in. in thickness prior to compacting. Each lift shall be compacted by two passes of a vibrating pad or drum type compactor.

No compaction control tests will be required.

**A. Underdrain Filter at Structures.** Underdrain filter at structures denotes the installation of Underdrain Filter, Type I placed behind bridge abutments, walls, and other major structures requiring positive drainage to relieve large lateral pressures resulting from a saturated backfill. Underdrain

Filter, Type I material shall be placed adjacent to structures in accordance with the contract documents. The lift thickness for the loose Type I material shall not exceed 6 in. and shall precede the placement of each lift of the adjacent backfill material. A physical barrier may be used to facilitate placement of the Underdrain Filter and adjacent backfill. This barrier shall not be left in place and shall be removed prior to compaction of the material. Each lift of filter material and backfill material located within a minimum distance of the footing heel projection plus 3 ft. shall be compacted simultaneously. Compactive effort for this material shall be provided by two passes of a vibratory or drum type compactor. Placement and compaction operations shall be conducted in a manner so as to ensure that the top surface of each lift of Type I filter material shall not be contaminated by the adjacent backfill materials. No compaction control tests will be required for the Type I filter material.

**605-4 METHOD OF MEASUREMENT**

**605-4.01 Underdrain Pipe.** Underdrain pipe will be measured in feet, measured to the nearest whole foot, installed in accordance with the contract documents.

**605-4.02 Underdrain Filter.** Underdrain filter material will be measured in cubic yards, measured to the nearest whole cubic yard, installed between the payment lines shown in the contract documents. A deduction to the cross sectional area of the underdrain trench will be made for the pipes (based on nominal diameters) when the combined cross-sectional area exceeds 1.0 sq. ft. No deduction will be made for the cross-sectional area of an existing facility.

**A. Underdrain Filter at Structures.** Underdrain filter, Type I material at structures will be measured in cubic yards, measured to the nearest whole cubic yard, installed between the payment lines shown in the contract documents. No deduction will be made for the volume occupied by the underdrain pipe.

**605-5 BASIS OF PAYMENT**

**605-5.01 Underdrain Pipe.** The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. The unit price bid per foot for perforated corrugated polyethylene underdrain tubing and perforated PVC underdrain pipe installations that are daylighted through the side slope shall include the shield pipe. Excavation, granular fill and backfill will be paid for separately.

**605-5.02 Underdrain Filter.** The unit price bid per cubic yard shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Excavation, granular fill and backfill will be paid for separately.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
605.04xx	Porous Concrete Pipe Underdrain	Foot
605.05xx	Extra Strength Porous Concrete Pipe Underdrain	Foot
605.07xx	Corrugated Steel Pipe - Type III	Foot
605.08xx	Corrugated Aluminum Pipe - Type III	Foot
605.0901	Underdrain Filter, Type I	Cubic Yard
605.1001	Underdrain Filter, Type II	Cubic Yard
605.1101	Underdrain Filter, Type III	Cubic Yard
605.15xx	Perforated Corrugated Polyethylene Underdrain Tubing	Foot
605.16xx	Perforated Polyvinyl Chloride Underdrain Pipe	Foot
605.17xx	Optional Underdrain Pipe	Foot

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

**SECTION 606 - GUIDE RAILING, MEDIAN BARRIER, AND CONCRETE BARRIER**  
(Last Revised January 1, 2021)

**606-1 DESCRIPTION.** This work shall consist of the construction, reconstruction, removal, disposal, storage, and resetting of highway barrier systems and component parts in accordance with the specifications, standard sheets, manufacturer’s drawings, manufacturer’s directions and contract documents to the lines and grades shown on the plans or established by the Engineer.

The types of barrier systems are designated as follows:

- Cable Guide Railing and Median Barrier.
- Corrugated Beam Guide Railing and Median Barrier
- Modified Heavy Post Blocked-Out (HPBO (Mod.)) Corrugated Beam Guide Railing and Median Barrier
- Box Beam Guide Railing and Median Barrier
- Concrete Barrier

**606-1.01 I-Beam Posts for Existing Highway Barrier.** Under this work the Contractor shall furnish and install I-beam posts and necessary hardware for existing highway barriers in accordance with the plans, specifications, and as directed by the Engineer.

**606-1.02 Guide Railing with Extra Long Posts.** Under this work the Contractor shall furnish and install guide railing of the type specified with extra long (7 foot) posts in accordance with the contract documents, and as directed by the Engineer.

**606-1.03 Retensioning Existing Cable Guide Railing And Median Barrier.** Under this work the Contractor shall retension existing guide rail and median barrier cables in accordance with the Contract Documents.

**606-2 MATERIALS.** Materials shall meet the requirements specified in the following subsections of Section 700-- Materials and Manufacturing and ASTM Specifications:

Concrete Grouting Material	701-05
Anchoring Materials-Chemically Curing	701-07
Precast Concrete Barrier	704-05
Premolded Resilient Joint Filler	705-07
Joint Filler	ASTM D1056
Wire Fabric For Concrete Reinforcement	709-02
Epoxy Coated Bar Reinforcement, Grade 60	709-04
Wood and Timber Posts and Timber Blockouts	710-13
Galvanized Steel Barrier Posts	710-14
Corrugated Beam Guide Railing End Terminal (Energy-Absorbing)	710-17
HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing)	710-18
HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing)	710-19
Corrugated Beam Guide Railing and Median Barrier	710-20



Box Beam Guide Railing and Median Barrier	710-21
Cable Guide Railing and Median Barrier.	710-22
Box Beam End Assembly Type III and Box Beam Median Barrier End Assembly, Type C	710-24
Plastic and Synthetic Block-Outs for Heavy Post Guiderail Systems	710-26
Anchor Bolts for Guide Railing	710-28
Galvanized Coatings And Repair Methods	719-01
Reflective Sheeting	730-05 (Materials Designation 730-05.02)
Paint for Galvanized Surfaces	708-06
Rolled Steel Channels for Continuity Connections	ASTM A36
Steel Plates for Continuity Connections	ASTM A36

**606-2.01 Steel Hardware.** Steel posts, plates, channels, stiffeners, block-outs, angles, brackets, slipbases and other miscellaneous steel hardware not referenced to or specified by §710-14, §710-20, §710-21, §710-22, §710-24 or other sections of this specification shall be fabricated as shown in the contract plans and documents from steel meeting the requirements of ASTM A36 unless specified otherwise. All components shall be galvanized in accordance with §719-01, Type I or II. Components shall be fabricated prior to galvanizing.

**606-2.02 Anchor Bolts.** For the purpose of the guide railing specifications, the term anchor bolt will be used when referring to anchor rods, hooks, or studs.

Unless otherwise specified, anchor bolts embedded or grouted in concrete for securing post and railing base plates, or transitioning to concrete walls, parapets, and barriers shall meet the requirements of §710-28.

Anchor bolts embedded in concrete anchorage units for terminating guide rail and median barrier systems shall have minimum yield and tensile strength meeting the requirements of ASTM F1554 Grade 36.

Anchor bolts, nuts, and washers shall be galvanized in accordance with §719-01, Galvanized Coatings and Repair Methods, Type II, unless indicated otherwise on the plans or Standard Sheets.

Grout for anchor bolts shall conform to the requirements of §701-07 or §701-05.

**606-2.03 Fasteners.** Bolts, nuts and washers shall conform to the following, unless specified otherwise on the plans, standard sheets, manufacturer's drawings, or in the contract documents.

Bolts	Bolts ASTM A307 Grade A	Nuts	ASTM A563 Grade A or Better
Washers	ASTM F436		

Bolts, nuts and washers shall be galvanized in accordance with the provisions of §719-01 Galvanized Coatings and Repair Methods, Type II.

**606-2.04 I-Beam Posts for Existing Highway Barrier.** I-beam posts for existing highway barrier shall conform to the requirements of §710-14 Galvanized Steel Barrier Posts. Posts shall conform to the details shown on the plans or the latest edition of the standard sheet for the guide railing or median barrier affected. Hardware (nuts, bolts, "J" bolts, offset beams or block-outs, back up plates, washers, and shelf angles) necessary shall conform to the requirements of the current specifications and standard sheets for the highway barrier affected.

**606-2.05 Extra Long Guide Rail Posts.** Extra long Guide Rail Posts shall conform to the requirements of §710-14 Galvanized Steel Barrier Posts. The posts shall conform to the details for extra long posts shown on the standard sheets or plans.

**606-2.06 Concrete for End Assembly Anchorage Units.** Cast-in-place concrete shall meet the requirements of Class A Concrete in Section 501 Portland Cement Concrete-General. The Contractor may submit, for approval by the Director of the Materials Bureau, a mix at least equivalent to the specified Class A Concrete, with a minimum cement content of 575 lb/cu yd.

Precast concrete anchorage units, when selected as an alternate to cast-in-place units by the Contractor, shall meet the requirements of Section 704-03 Precast Concrete-General.

#### **606-2.07 Concrete Barrier**

**A. Precast Concrete Barrier.** The requirements of §704-05 shall apply

**B. Cast-in-Place Concrete Barrier.** Concrete shall meet the requirements specified for Class A Concrete in §501, Portland Cement Concrete--General. Reinforcement shall meet the material requirements §606-2 and be of the type and sizes as indicated on the standard sheets and plans.

**C. Machine Formed Concrete Barrier.** The concrete shall meet the requirements specified for Class I Concrete in §501, Portland Cement Concrete--General. Reinforcement shall meet the material requirements of §606-2 and shall be of the type and sizes as indicated on the standard sheets and plans.

**606-2.08 Resetting Guide Railing, Median Barrier, Anchorage Unit Assemblies and End Assemblies.** The materials comprising the existing system shall be used if they conform to the materials requirements specified for new guide rail systems and are found to be in satisfactory condition as determined by the Engineer. The Contractor shall supply all new hardware (splice tongues, plates, nuts, bolts, washer, etc.) Replacement materials shall meet the material requirements specified for new guide rail systems. Galvanizing of railing and posts may be repaired in accordance with §719-01, Galvanized Coatings and Repair Methods. HPBO guide railing and median barrier (pre-2013 design) shall be reset as detailed in the current standard sheets, including 12 inch block-outs.

**606-2.09 HPBO (Mod.) Corrugated Beam Guide Railing and Median Barrier.** The material requirements of §710-20 Corrugated Beam Guide Railing and Median Barrier shall apply except that posts, block-outs, soil plates, anchor bolts, hardware, and fasteners shall be as detailed on the Standard Sheets. The Wood and Timber Posts and Timber Block-Outs shall conform to §710-13. The Plastic and Synthetic Block-Outs for Heavy Post Guiderail Systems shall conform to §710-26.

**606-2.10 Corrugated Beam Guide Rail Transition To Bridge Rail, Concrete Barrier and Concrete Parapets.** Corrugated beam rail sections shall conform to the requirements of §710-20 and as detailed on the Standard Sheets or Bridge Detail Sheets. Thrie beam shall conform to the material specifications of 710-20 and shall be as detailed on the Standard Sheets.. All remaining material shall conform to the requirements of §710-23 except that:

- A. Steel tubular block-outs and stiffening channels, where specified, shall conform to ASTM A36.
- B. All components shall be galvanized in accordance with §719-01 *Galvanized Coating and Repair Methods*, Type I or Type II. If required by the plans, the components shall be painted to match the existing railing. Painting shall be done in accordance with Section 657 except that:
  - 1. Painting with rollers will not be permitted.
  - 2. Spray painting will be allowed only if the components are painted at a location, away from the work site, acceptable to the Engineer.
- C. Shop drawings will not be required. Approval of the system will be made by the Engineer.

**606-2.11 Vacant.**

## 606-2.12 Vacant

## 606-2.13 (Vacant)

**606-2.14 Transitions Constructed of, or with, Concrete.** Concrete transition between concrete barriers of different shapes and the concrete elements of transitions between metal barriers and concrete barriers shall conform to §606-2.07 Concrete Barrier, A. Precast Concrete Barrier or, with the permission of the Engineer, B. Cast-in-Place Concrete Barrier.

## 606-3 CONSTRUCTION DETAILS

**606-3.01 General.** All barrier systems and transitions described by these specifications shall be subject to the following requirements.

**A. Inspection of Rail Elements.** Immediately prior to erection, the rail elements shall be inspected for damage. Bends or kinks in the railing, not specifically required by the contract documents, shall constitute sufficient cause for rejection. Straightening of such bends or kinks will not be allowed.

Erection of all guide rail, median barrier, transitions and connections shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

**B. Field Galvanizing For Repair.** Field galvanizing repair shall be allowed only when the total damaged area on each piece or component is less than 2 percent of the coated surface, or 16 square inches, whichever is less. Any single piece or component with total damaged area greater than the amount specified above shall be rejected and replaced by the Contractor. Field galvanizing repair shall be done in accordance with the requirements of the Repair section of §719-01 Galvanized Coating And Repair Methods.

**C. Field Welding.** Field welding shall not be permitted unless noted in the contract documents. When specified, welding shall comply with the requirements of the SCM.

**D. Erection.** Posts, railing, barrier systems, rail transitions, end assemblies, and anchorage units shall be erected as specified in the contract plans or manufacturer's drawings. Where drilling and grouting is required, Section 586 – *Miscellaneous Structural Reconstruction* shall apply, unless otherwise approved. Rail mounting height shall be within +/- 1/4 inch of that indicated on the Standard Sheets and plans.

Prior to installing guide rail, median barrier, transitions, or end terminals, the Contractor shall determine the locations of all structures, including underground structures, that may be affected by the installation. If there are conflicts between the proposed installation and other structures, the Contractor shall discuss with and recommend to the Engineer alternative locations or types of barrier, transitions, or end terminals that will not be in conflict with the structure.

Posts and foundation tube(s) shall be driven unless otherwise specified by the Engineer. The driving shall be accomplished with approved equipment and methods that will leave the posts and foundation tube(s) in their final position, free of any distortion, burring or other damage. When posts and foundation tube(s) are driven through asphalt concrete or a bituminous treated material, the Contractor shall take care to prevent damage to the paved or treated areas. Large holes and voids caused by driving the posts and foundation tube(s) shall be filled and compacted with a bituminous treated material or asphalt concrete similar to that damaged. The small area adjacent to the post and foundation tube(s) disturbed during installation or where gaps exist at the post and foundation tube(s) after pavement repairs shall be sealed with a bituminous material approved by the Engineer.

As an alternate to driving posts and foundation tube(s) on unpaved medians and where site conditions are such that driving is not possible, the Contractor shall carefully excavate for all post and foundation tube(s) holes. Post and foundation tube(s) holes and post and foundation tube(s) foundation structures shall be backfilled and backfilled material compacted in accordance with Section 203, *Select Granular Fill* .

On structures, concrete anchors, and paved medians, base plates for posts shall be anchored as shown in the Contract Documents. Alternate construction methods and equipment for drilling and grouting of holes shall be submitted to the Engineer for approval before operations begin. The work of installing the guide railing system when it abuts stabilized shoulder courses shall be coordinated and progressed to provide the least disturbance between the two phases of the work.

All posts shall be aligned to a tolerance of 1/4 inch for plumb and grade line.

Box beam to be installed on a curved alignment shall be shop bent or shop curved in accordance with Table 606-1.

<b>TABLE 606-1 SHOP BENDING AND SHOP MITERING OF BOX BEAM GUIDE RAILING AND MEDIAN BARRIER</b>		
<b>Barrier Type</b>	<b>Shop Bending Required</b>	<b>Shop Mitering Required</b>
Box Beam Guide Railing	Radius over 20 ft and less than 720 ft	Radius of 20 ft or less
Box Beam Median Barrier	Radius over 30 ft and less than 1525 ft	Radius of 30 ft or less

When shop bending or shop mitering of box beam guide railing or box beam median barrier is required, the rail element shall be shop-worked to the radius that the barrier will be installed on.

Corrugated beam guide railing and median barrier shall require shop curving if the radius is equal to or less than 150 feet. When shop curving of corrugated beam is required, the rail element shall be shop-worked to the radius that the barrier will be installed on.

**E. Concrete Anchorage Units.** Concrete anchors shall be constructed as detailed on the standard sheets. Excavation shall meet the requirements of §206-3 of the Standard Specifications. The bottom of the anchor shall have a full and even bearing on the surface under it. After the concrete anchor is in place, the excavation shall be backfilled in accordance with Section 203, *Select Granular Fill* .

**F. End Terminals and Assemblies.** Installation of all proprietary products shall follow the manufacturer’s instructions. The following shall apply to end terminals or assemblies to be installed under this section.

**1. Drawings.** For end terminals and end assemblies not shown on standard sheets or detailed in the plans, the Contractor shall submit two copies of the manufacturer’s drawings, modified as necessary to reflect site conditions, to the Engineer for approval prior to ordering any materials required under this section. Drawings of parts not detailed on the plans, but which are necessary to develop the full performance of the end assemblies or terminals shall also be provided. The Contractor shall commence work of installation of end assemblies or terminals only after approval of the above mentioned drawings and authorization from the Engineer to do so.

**2. Manuals.** In addition to the drawings mentioned above, the Contractor shall deliver to the Engineer two (2) copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type end terminal or assembly being installed but not shown on the standard sheet.

**3. Coordination with Other Work.** The work of furnishing and installing all types of end assemblies shall be coordinated with the removal of existing impact attenuators or end assemblies, the installation of guide railing or median barrier, or the installation of the object to be shielded, so as to minimize the time that motorists are exposed to the possibility of collision with the shielded object, unprotected ends of barriers, or incomplete end terminals or assemblies. Also, the contractor shall minimize exposure of approaching vehicular traffic to the possibility of impact on the back of the end assembly. Unless modified in the Contract Documents, minimization shall mean seven (7) or fewer calendar days.

**4. Traffic Protection.** Traffic protection shall be provided as specified in Section 619 *Work Zone Traffic Control*.

**5. Reflective Sheeting.** End terminals and assemblies which have a vertical face towards approaching traffic and are located on or closely adjacent to the shoulder shall be provided with reflective sheeting in accordance with Section 2C.65 of the MUTCD. The yellow and black stripe widths shall be 4 inches.

**606-3.02 Cable Guide Railing and Median Barrier.** Beginning with the first post where the rail is parallel to the edge of pavement, every sixth post in the line of guide rail shall be reflectorized (96 foot spacing for reflectors) except those posts in the approach terminal and intermediate anchorage area, which curve away from the shoulder, or used in a median barrier. The reflector and method of attachment shall be as indicated on the standard sheet.

**A. Anchorage Unit Assemblies.** After the posts are driven to the specified line and grade, anchor angles and anchor posts shall be adjusted in the field to provide a full and even bearing on the underlying surface.

**B. Cable Tensioning.** The Contractor shall install and tension the cable of guide railing and median barrier as follows: Properly seat the spring compensation device and then permanently mark the unloaded position. Complete the assembly of the guide railing and set the compensating devices to a spring compression of 3 1/2 inches. Leave the springs at this setting for at least 2 weeks, then set them to the proper setting according to temperature from the data in the table on the standard sheets.

**C. Cable Splicing.** The Contractor shall install cable splices in the following manner: Place a splice end over the cable. Twist the cable to separate the three strands. Insert the wedge into the center of the strands, leaving at least one inch of excess cable, and pull the cable back until the wedge is snug to the splice. Pound the wedge into the splice. Crimp at least one wire of the cable over the wedge. Repeat the procedure for the other cable. Connect the two splice ends together.

**606-3.03 Box Beam Guide Railing and Median Barrier.** Rail sections for tangent runs shall be at least 18 feet long. Rail splices shall be a minimum of 18 inches from the centerline of any post.

**606-3.04 Weak Post and HPBO (Mod.) Corrugated Beam Guide Railing and Median Barrier** In the erection procedures, the free end of the rail element shall not be allowed to swing free and cantilever around the mounting bolt. The free end shall be supported in a manner approved by the Engineer while the splice bolts and mounting bolts are fastened. Rail splicing shall be as shown on the Standard Sheets.

**A. Weak Post Corrugated Beam Guide Railing and Median Barrier.** The rail elements shall be installed so the weight of the beam rests on the double nutted support bolt before the 5/16 inch

mounting bolts are torqued. Before the final torquing, six of the 5/16 inch mounting bolts in the installation shall be selected at random and with a suitable torque wrench tightened to failure. The six readings shall be averaged, the six failed bolts replaced and all the mounting bolts in the installation torqued to 50% of the average value.

Support bolts shall be installed on all the guide rail posts except the three posts adjacent to the anchors.

**B. HPBO (Mod.) Corrugated Beam Guide Railing and Median Barrier.** HPBO (Mod.) guide railing shall be erected from the approach-end anchorage unit and downstream along the flow of traffic.

HPBO (Mod.) median barrier shall be erected from one of the anchorage sections and shall be completed as the work progresses.

HPBO (Mod.) guide railing and median barrier connections to walls or Concrete Barriers shall be as specified on the plans or the Standard Sheets.

During non-working hours, no uncompleted anchorage units or heavy posts without rail will be permitted to be exposed to traffic on either guide railing or median barrier.

**606-3.05 Concrete Barrier.** Unless specified otherwise in the contract documents the Contractor shall have the option of providing precast concrete barrier, cast-in-place concrete barrier, or machine formed barrier. No intermixing in any run of barrier will be permitted unless shown otherwise in the contract documents except that precast transition sections and ends may be used with cast-in-place or machine formed concrete barriers.

Unless otherwise specified, excavation shall be performed in accordance with §206-3. Granular back fill shall conform to Section 304 and shall match the subbase course type used on the adjacent roadway.

Half section concrete barrier shall be erected with the appropriate back-up posts and continuity plates as shown on the Standard Sheets and plans.

#### **A. Precast Concrete Barrier**

**1. Placement.** Immediately prior to installation, the Engineer shall inspect the sections for manufacturing defects or shipment damage. Damaged or defective sections shall be rejected or repaired in accordance with §704-05. Precast Concrete Barrier, Repair. The sections shall be placed in accordance with the contract plans and proposals.

**2. Vertical Expansion Joint.** Sections shall be separated by 1/2 inch nominal joint openings. The joint opening, at any point in the plane of the joint, shall not vary by more than 1/4 inch. Premolded Resilient Joint Filler conforming to the requirements of §705-07 or Joint Filler conforming to the requirements of ASTM D1056 class 2B1 or 2B2 shall be placed in the joint as shown on the plans, standard sheet or as directed by the Engineer.

#### **3. Dimensional Tolerance.**

- a. Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
- b. The barrier shall not be out of plumb by more than 1/4 inch.
- c. Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
- d. When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

**4. Placement Adjacent to Cement Concrete.** The barrier shall be separated from cement concrete pavement or shoulders by a 1/2" thick ( $\pm 1/8$ ") premolded resilient joint filler meeting §705-07. The joint filler shall cover the entire pavement/shoulder face. A joint sealant reservoir 1/4" - 1/2" deep

shall be formed or routed in the joint filler. The Contractor shall abrasive blast the barrier and pavement/shoulder in the reservoir, and seal the joint using material meeting §705-02, Highway Joint Sealant, Type IV. Sealing shall be done in accordance with the manufacturer's instructions, a copy of which shall be provided to the Engineer prior to commencement of work.

## ***B. Cast-in-Place Concrete Barrier***

**1. *Placing.*** Cast-in-place concrete barriers and footings shall not extend more than 200 feet without an expansion joint. The Contractor shall have the option of placing the cast-in-place concrete barrier with a monolithic cross-section or with a horizontal construction joint at the top of the footing. When the Contractor elects to cast a separate footing, the horizontal joint details must conform to those on the Standard Sheets or in the plans, or the Contractor must prepare joint details and submit them to the Regional Director for approval.

### ***2. Joints***

**a. *Contraction Joints.*** Cast-in-place concrete barrier shall have contraction joints every 20 feet in both the footing and the stem. When cast separately, the joints in the stem shall line up with the joints in the footing. Contraction joints shall be formed in or saw cut normal to the pavement. The joints shall conform to the dimensions as shown on the plans or Standard Sheets. If the joints are saw cut, they shall be saw cut as soon as no damage to the concrete will result, with a maximum time of 2 hours after the forms are removed to avoid early formation of uncontrolled shrinkage cracks. Clear curing compound shall be promptly applied to the saw cut.

**b. *Expansion Joints.*** Expansion joints shall be formed normal to the pavement with Premolded Resilient Joint Filler meeting the requirements of §705-07 and shall provide for expansion of ½ inch. The filler material shall be cut to fully cover and conform to the cross section of the barrier, or to the footer and stem separately if they are cast separately.

In addition to the maximum separation of 200 feet, expansion joints shall be located at all immovable objects (bridge substructures, etc.), where shown on the plans, and/or as directed by the Engineer.

**c. *Construction Joints.*** When the Contractor's operations require the use of a construction joint, one of the two following procedures may be used. However, if operations will not resume within 24 hours, only method A may be used.

*Method A.* Construct an expansion joint as detailed in the preceding section.

*Method B.* After initial set has taken place, remove the end form to expose the concrete. Roughen the surface to achieve a good interlock and increased bond area when the concrete operations are resumed. A one-inch strip around the periphery of the end surface should remain undisturbed to serve as a neat, linear contraction joint. The end surface shall be covered with several layers of wetted burlap to prevent drying. All reinforcing steel shall extend beyond the face to provide adequate lapping.

**3. *Forms.*** Forms shall be metal and of such construction that there will be minimum interference to inspection for grade and alignment. Forms shall be braced and secured adequately so that no discernible displacement from alignment or grade will occur during placement of concrete.

**4. *Concrete Placing and Vibrating.*** Concrete shall be placed in the barrier forms in accordance with the requirements of §555-3.04 Handling and Placing Concrete. Concrete shall be compacted by means of immersion type mechanical vibrators approved by the Engineer. The vibrator shall

be inserted into the concrete at one foot intervals. The vibrators shall be of size and weight sufficient to thoroughly vibrate the entire concrete mass without damaging or misaligning the forms or reinforcement.

**5. Removal of Forms and Finishing Surfaces.** Forms shall be left in place for 24 hours or until, in the judgment of the Engineer, the concrete has sufficiently set so that the forms may be removed without injury to the barrier. Immediately after the forms have been removed, surfaces exposed to view shall have all projections and irregularities carefully removed and all cavities neatly filled with mortar of the proportion used in the concrete. The same brand of cement and the same kind of fine aggregate shall be used for filling cavities as was used in the original concrete mix. Surfaces repaired by plastering will not be allowed.

**6. Curing.** The median barrier shall be cured using a clear curing compound meeting the requirements of §711-05. The compound shall be sprayed on the concrete surfaces at a rate of 1 gal/ 150 sf within one hour of form removal.**7. Reinforcement.** The Contractor shall incorporate reinforcement as indicated on the standard sheets and plans. All reinforcing steel shall be epoxy coated meeting the requirements of §709-04.

**8. Placement Adjacent to Cement Concrete Pavement or Shoulders.** The barrier shall be separated from the cement concrete pavement or shoulder by a 1/2 inch wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and contain Premolded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately one inch shall be provided at the top of the joint for installation of a backer rod and joint sealant. The joint sealant shall be a silicone sealant appearing on the Department's Approved List and shall be applied in accordance with the manufacturer's instructions.

### **9. Dimensional Tolerance**

- a. Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
- b. The barrier shall not be out of plumb by more than 1/4 inch.
- c. Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
- d. When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

## **C. Machine Formed Concrete Barrier**

**1. Weather Limitations.** The requirements of §502-3.01 shall apply.

**2. Equipment.** The slipforming equipment shall be self-propelled and shall be capable of placing, consolidating and finishing concrete to the proper line and grade. The Engineer may require the Contractor to demonstrate that the specific equipment proposed for use is capable of satisfactorily placing the concrete mix. The Contractor shall furnish the manufacturer's data regarding machine operation to the Engineer.

**3. Preparation of the Subbase Course.** Before any concrete may be placed, the subbase course shall be compacted and fine graded to a tolerance of  $\pm$  1/2 inch of the true grade at any location under the barrier. Whenever possible, as determined by the Engineer, concrete placing operations shall not begin until the subbase course has been fine graded ahead at least 1000 feet.

**4. Reinforcement.** The Contractor shall incorporate reinforcement as indicated on the standard sheets and plans. All reinforcing steel shall be epoxy coated meeting the requirements of §709-04.



## 5. *Placing Operations*

*a. Central and Transit Mixed Concrete.* The provisions of §501-3.03 C and D shall apply for Central Mixed and Transit Mixed Concrete respectively, except that water may be added at the point of deposition to maintain the desired slump. The water addition may be made at any time after the beginning of the discharge until approximately two-thirds (2/3) of the load, as determined by the Engineer, has been discharged. After the water addition the concrete shall be mixed at least 30 revolutions in the mixing range. When the water additions made after discharge the total number of revolutions shall not be more than 190.

*b. Truck Mixed Concrete.* The provisions of §501-3.03 E shall apply except that after the initial slump has been achieved, water may be added to the mixture one additional time to maintain the desired slump. The water addition may be made anytime after the beginning of discharge until approximately two-thirds (2/3) of the load, as determined by the Engineer, has been discharged. After the water addition, the concrete shall be mixed at least 30 revolutions in the mixing range.

The slipforming equipment shall have as nearly a continuous forward movement as possible to provide uniform progress with stopping and starting of the equipment held to a minimum. Any edge slump resulting from slipforming operations in excess of 1/4 inch, as measured from the top surface of the median barrier, exclusive of edge rounding, shall be corrected before the concrete has hardened.

Concrete supply shall be sufficient to produce a continuous, completely shaped barrier. If concrete placement is interrupted for a period of time where the delay will affect the quality and structural integrity of the barrier, the contractor shall terminate his operations by one of the following procedures. The Engineer shall determine when the slipform operation is to be terminated.

*Method A.* Construct a cast in place expansion joint system as detailed on the standard sheets.

*Method B.* Remove existing unset concrete to a vertical score line with hand tools. The vertical surface resulting from the removed concrete shall remain reasonably rough and unfinished to facilitate interlock and increased bond area when concrete operations are to be resumed. The vertical surface shall be touched up with hand tools, as directed by the Engineer, to correct unacceptable voids, tears and lack of consolidation resulting from the concrete removal. The surface shall be covered with several layers of wet burlap to prevent drying. All reinforcing steel shall extend beyond the face to provide adequate lapping.

Concreting operations may resume at the terminated face when the terminated portion has achieved enough rigidity to withstand the sequence of operations it will be subjected to without sustaining damage. All loose or unacceptable concrete and material shall be removed from the terminated face as directed by the Engineer. Concrete barrier damaged as a result of the contractor's operations shall be repaired to the satisfaction of the Engineer.

Termination of slipform operations at the end of the day for an uncompleted run shall be by method A or B above.

**6. *Curing.*** The median barrier shall be cured using a clear curing compound meeting the requirements of §711-05. The compound shall be sprayed on the concrete surface immediately following the placing operation at a rate of 1 gal/ 150 sf.

**7. Placement Adjacent to Cement Concrete Pavement or Shoulders.** The barrier shall be separated from the cement concrete pavement or shoulder by a 1/2 inch wide vertical joint extending down to the bottom of the pavement or shoulder. The joint shall be formed with and contain Premolded Resilient Joint Filler conforming to the requirements of §705-07. A recess of approximately one inch shall be provided at the top of the joint for installation of a backer rod and joint sealant. The joint sealant shall be a silicone sealant appearing on the Department's Approved List and shall be applied in accordance with the manufacturer's instructions.

**8. Contraction Joints.** Contraction joints shall be formed or saw cut normal to the pavement. The spacing shall be every 20 feet, as shown on the plans or as ordered by the Engineer. The joints shall conform to the dimensions as shown on the plans or standard sheets. If the joints are saw cut, they shall be saw cut as soon as no damage to the concrete will result, with a maximum time of 8 hours. The clear curing compound shall be reapplied at the saw cut.

**9. Expansion Joints.** Machine formed concrete barriers shall not extend more than 400 feet without an expansion joint. Expansion joints shall be formed normal to the pavement with Premolded Resilient Joint Filler meeting the requirements of §705-07 and shall provide for expansion of 1/2 inch. The filler material shall be cut to conform to the cross section of the barrier.

The expansion joints shall be located at all immovable objects (bridge substructures, etc.), where shown on the plans, and/or as directed by the Engineer. Expansion joints shall not be required at regular intervals unless shown on the plans.

**10. Tolerances.** All concrete barrier produced by this method shall conform to the following tolerances:

*a. Placing Tolerances*

- (1) Bar Reinforcement Cover 0 to + 1/2 inch.
- (2) Width (top) 0 to + 1/4 inch.
- (3) Width (base) 0 to + 1/2 inch.

*b. Dimensional Tolerance*

- (1) Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
- (2) The barrier shall not be out of plumb by more than 1/4 inch.
- (3) Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 foot of the barrier.
- (4) When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

**11. Defects.** Defects are divided into two categories Minor defects and major defects. Minor defects in the barrier may be repaired in the field. Major defects shall be cause for rejection of the section, or the section shall be repaired in the manner directed by the Engineer.

*a. Minor Defects.* Minor defects are defined as holes, honeycombing or spalls which are 6 inches or less, in diameter, and which do not expose the outermost surface of the steel reinforcement. Surface voids 5/8 inch, or less, in diameter and 1/4 inch, or less, in depth are not considered defects and they do not require repair.

*b. Major Defects.* Major defects are defined as:

- (1) Any defect which does not meet the definition of a minor defect.
- (2) Minor defects which, in aggregate, comprise more than five percent (5%) of the surface area of the barrier section.

**12. Repair.** Repair of hardened concrete shall be as follows:

*a. Minor Defect Repair.* Repair shall be made with a material meeting the requirements of §701-04 or §701-12. Methods of repair shall be acceptable to the Engineer. The color of the repaired portion shall match as nearly as practicable, the color of the surrounding concrete. Repaired portions shall exactly match shape requirements. The repaired portion shall withstand a moderate blow from a 16 ounce hammer.

*b. Major Defect Repair.* Major defect repair shall be preapproved by the Engineer.

**13. Hand Finishing.** The Contractor shall make provisions to allow hand finishing, when directed by the Engineer, on all surfaces. Hand finishing, if done shall be done immediately after the passage of the slipforming equipment. Curing compound shall be applied only after hand finishing has been completed at any particular location.

**14. Transitions and Tapered End Sections.** Transitions and tapered end sections shall be either cast-in-place or precast, at the Contractor's option."

**606-3.06 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier.** The Contractor shall remove, store, clean and reset railing, posts, and precast concrete barrier as shown on the plans or as directed by the Engineer. The Contractor shall remove designated existing guide railing, median barrier and precast concrete barrier and neatly store them at locations approved by the Engineer. The work shall be done in a workmanlike manner so as to salvage all usable parts. The reset guide railing and/or median barrier shall be placed in accordance with the requirements of §606-3.01 General and the subsection for each specific system. Unless otherwise specified by the designer, all existing hardware, i.e., post bolts, J-bolts, splice bolts, etc., shall be replaced with new hardware. Cable systems shall be retensioned and all existing splice couplings and wedges shall be replaced. HPBO guide railing and median barrier (pre-2013 design) shall be reset as detailed in the current standard sheets, including 12 inch block-outs. The existing block-outs shall become the property of the Contractor.

**606-3.07 Resetting Guide Railing and Median Barrier (New Posts).** The construction details of §606-3.06 shall apply, except that the Contractor shall furnish and install new posts and remove the old posts from the site.

**606-3.08 Removing and Storing Guide Railing, Median Barrier, and Precast Concrete Barrier.** The Contractor shall remove designated existing guide railing, median barrier and precast concrete barrier and neatly store the component parts in separate piles at locations designated for future pick up by Department forces, or its designee. The work shall be done in a workmanlike manner so as to salvage all usable parts. Unusable material shall be disposed of by the Contractor.

**606-3.09 Removing and Disposing of Guide Railing, Median Barrier, Concrete Barrier, Guide Posts, Guide Rail Posts, and Median Barrier Posts.** The Contractor shall remove designated existing guide railing, median barrier, concrete barrier, guide posts, guide rail posts, and median barrier posts and remove them from the site of work. Holes shall be backfilled with a suitable material and compacted in a manner approved by the Engineer.

**606-3.10 I-Beam Posts for Existing Highway Barrier.** I-beam posts for existing highway barrier shall be installed at the locations indicated in the contract documents or where directed by the Engineer. The driving shall be in accordance with the requirements of §606-3.01 and the applicable standard sheet(s). All hardware necessary for mounting the rail elements or cable to the post shall be supplied by the Contractor. New heavy post block-outs shall be supplied to replace damaged or unusable block-outs. S3x5.7 posts installed as intermediate posts to reduce post spacing on weak post corrugated beam guide railing and median barrier and on box beam guide railing shall not be attached to the rail element.

All reflectors, delineators, reference markers, or other items, which are to remain in place, that are damaged by or during the Contractor's operations shall be replaced by the Contractor.

**606-3.11 Retensioning Existing Cable Guide Railing and Median Barrier.** Cable guide rail and median barrier shall be retensioned in accordance with the cable tensioning requirements of §606-3.02.

**606-3.12 Resetting Anchorage Unit Assemblies and End Assemblies for Guide Rail and Median Barrier.** The Contractor shall remove, store, clean and reset existing anchorage units and terminals for Guide Railing and Median Barrier as shown on the plans or as directed by the Engineer. The anchorage units and terminals shall be reset and placed in accordance with the requirements of §606-3.01 General.

Any anchor blocks that will not remain in use in their existing location are to be removed and the holes backfilled as detailed in §606-3.13

The Contractor shall take care so reusable parts are not damaged by their operations. Any parts damaged in handling and placing shall be replaced by the Contractor. Unusable material shall be disposed of by the Contractor.

Surface areas disturbed during the removal operations shall be reestablished, as nearly as possible, to match the adjacent surfaces to remain.

**606-3.13 Removing and Storing Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barriers** The construction details of §606-3.08 shall apply. However, concrete anchor blocks shall be completely removed, and the resulting holes backfilled.

If the center of the anchor block is inboard from a line six feet beyond the theoretical shoulder break, the Contractor shall backfill with material meeting the requirements of §733-04 compacted in 6-inch lifts.

If the center of the anchor block is more than six feet past the shoulder break, the backfill material and compaction shall be replaced in kind, character and condition, compacted in 6-inch lifts.

Other excavation and backfill shall conform to the requirements outlined in §606-3.01E.

Roadway edge drains damaged due to the Contractor's operations shall be repaired or replaced at no additional cost to the State.

**606-3.14 Removing and Disposing Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barriers.** The construction details of §606-3.13 shall apply except the anchor blocks and terminals become the property of the Contractor and shall be removed from the project.

**606-3.15 Box Beam Guide Rail Transition to Concrete Barrier.** The contractor shall construct a guide rail transition from concrete barrier to box beam guide rail at the locations indicated and as detailed on the contract plans. The work shall conform to the requirements of §606-3.01.

**606-3.16 Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and Concrete Parapets.** The contractor shall construct corrugated beam guide transitions to bridge rail, concrete barrier

and/or concrete parapets at the locations and as detailed on the contract plans. The requirements of §606-3.01 shall apply together with the following: Railing shall be erected so that the rails are parallel to the roadway, except in those sections where it is necessary to vertically transition the highway barrier to the bridge railing, or barrier. Bending or curving of rail elements in order to fit alignment requirements in the field shall not be permitted. The Engineer may order some bending or curving to allow for necessary minor adjustments. The Contractor shall exercise care in attaching the guide rail to the bridge rail so as not to damage the rails, posts, or joints, or splices. Any damage to the material attributable to the Contractor's operation shall require that the material be repaired, or replaced. The decision to repair, or replace, shall rest solely with the Engineer.

#### **606-3.17 Vacant.**

#### **606-3.18 Vacant**

**606-3.19 Transitions Constructed of, or with, Concrete.** Transitions constructed of concrete and the concrete elements of transitions constructed of metal components and concrete elements shall be constructed at the locations indicated in the contract documents, or those indicated by the Engineer, in accordance with these specifications, the contract documents, and the directions of the Engineer. The shapes indicated on the Standard Sheets are standard. The Deputy Chief Engineer (Design) will consider other shapes for approval.

§606-3.05 Concrete Barrier, A. Precast Concrete Barrier and B. Cast-in-Place Concrete Barrier shall apply.

### **606-4 METHOD OF MEASUREMENT**

**606-4.01 Cable, Corrugated Beam or Box Beam Guide Railing and Median Barrier.** The quantity to be measured for payment will be in feet to the nearest foot of guide railing or median barrier installed, measured along the axis of the railing and between its pay limits as shown on the plans and/or standard sheets. The quantity to be measured for payment will be in feet to the nearest foot of shop bent or shop mitered guide railing or median barrier installed. If the guide railing does not terminate at an anchorage unit, end assembly, or transition to another type of barrier, but is anchored to a structure, the railing will be measured up to the structure.

**606-4.02 Anchorage Units, End Assemblies and Transitions for Guide Railing or Median Barrier.** Anchorage units, end assembly units and transitions between various highway guide railing and median barrier systems will be measured by the actual number of units installed in accordance with the plans, standard sheets, manufacturer's drawings', manufacturer's directions and/or as directed by the Engineer.

The payment limits for the Box Beam Guide Rail End Assembly Type III and Box Beam Median Barrier End Assembly, Type C will be separated by a distance of 50 feet extending along the end assembly from the front of the Nose Assembly to a point 50 feet removed. These payment limits apply regardless of whether the Type III End Assembly or Type C End Assembly employs crushable fiberglass elements or beam bursting type mandrels to absorb the energy of the impacting vehicle.

The limits of payment for the Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) will extend a distance of 100 feet from the outer end of the terminal. At that point, payment will begin for corrugated beam guide railing.

The limits of payment for HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) will extend a distance of 50 feet from the outer end of the terminal. At that point, payment will begin for heavy post blocked-out corrugated beam guide railing.

The limits of payment for HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing) will extend a distance of 50 feet from the outer end of the terminal. At that point, payment will begin for heavy post blocked-out corrugated beam median barrier.

**606-4.03 Concrete Barrier and Terminal Sections.** The quantity of concrete barrier and terminal sections measured for payment will be the number of feet placed in accordance with the plans and specifications, measured along the axis of the barrier and between its extreme outer limits, unless otherwise indicated on the plans or in the proposal.

**606-4.04 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier.** The quantity of reset guide railing or median barrier measured for payment will be the number of feet reset in accordance with the specifications, plans and as directed by the Engineer, exclusive of anchorage units and end assemblies. If the guide railing is anchored to a structure instead of an anchorage unit or end assembly, measurement will be made up to the structure. The quantity of reset precast concrete barrier measured for payment will be the number of feet placed in accordance with the plans and specifications measured along the axis of the barrier between its extreme outer limits.

**606-4.05 Resetting Guide Railing and Median Barrier (New Posts).** The Method of Measurement of §606-4.04 will apply.

**606-4.06 Removing and Storing Guide Railing, Median Barrier and Precast Concrete Barrier.** The quantity of removed and stored guide rail and median barrier measured for payment will be the number of feet removed in accordance with the specifications, plans, and as directed by the Engineer, exclusive of anchorage units and end assemblies. If the guide rail or median barrier is anchored to a structure, measurement will be made up to the structure. The quantity of removed and stored precast concrete barrier measured for payment will be the number of feet removed in accordance with the specifications and plans, measured along the axis of the barrier between its extreme outer limits.

**606-4.07 Removing and Disposing of Guide Railing, Median Barrier and Concrete Barrier.** The quantity of guide rail and median barrier measured for payment will be the number of feet of railing and posts removed and disposed of in accordance with the specifications and plans, exclusive of anchorage units and end assembly components that would not be used in the middle of a continuous run. The quantity of concrete barrier measured for payment will be the number of feet removed and disposed of in accordance with the specifications and plans measured along the axis of the barrier between its extreme outer limits and including any backup posts.

**606-4.08 Removing and Disposing of Guide Posts, Guide Rail Posts, and Median Barrier Posts.** The quantity to be measured for payment will be the number of posts removed and disposed of in accordance with the specifications and plans and as directed by the Engineer.

**606-4.09 Resetting Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barrier** This work shall be measured by the number of anchorage units and/or terminals reset in accordance with the requirements of the contract documents.

**606-4.10 Removing and Storing or Disposing of Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barrier.** This work shall be measured by the number of Anchorage Units or End Assemblies properly removed and stored for pick up by others or removed and disposed of in accordance with the contract documents and to the satisfaction of the Engineer

**606-4.11 Retensioning Existing Cable Guide Railing and Median Barrier.** Quantity measured for payment will be the number of sections retensioned. A section shall consist of the length of cable guide rail or median barrier running between two concrete anchorage units.

**606-4.12 Vacant.**

**606-4.13 Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and Concrete Parapets.** Measurement will be taken as the actual number of transition units installed in accordance with the plans and specifications.

**606-4.14 Box Beam Guide Rail Transition to Concrete Barrier.** Measurement will be taken as the actual number of transition units installed in accordance with the specifications, plans and standard sheets.

**606-4.15 Vacant**

**606-4.16 I-Beam Posts for Existing Highway Barrier.** I-beam posts for existing highway barrier will be measured by the actual number of posts installed in accordance with the contract documents and as directed by the Engineer.

**606-4.17 Transition between Concrete Sections.** Transitions will be measured by the actual number of units installed in accordance with the plans, standard sheets and/or as directed by the Engineer.

<b>Payment Factor</b>	<b>1.0</b>	<b>1.1</b>	<b>1.3</b>	<b>1.4</b>	<b>1.6</b>	<b>1.8</b>	<b>1.9</b>
<b>Rail Type</b>	<b>Post Spacing Center to Center in Feet &amp; Inches</b>						
Cable*	16'	12'	---	8'	---	---	4'
Box Beam	6'	---	3'	---	---	---	---
Corrugated Beam	12'6"	---	---	6'3"	4'2"	---	3' 1 1/2"
HPBO (Mod.) Corrugated Beam	6'3"	---	---	---	---	3' 1 1/2"	---

\* For cable guide rail, the post spacing in the typical approach, terminal sections and typical intermediate anchorage sections as indicated on the standard sheets, shall have payment factors of 1.0.

**606-5 BASIS OF PAYMENT**

**606-5.01 Guide Railing, Median Barrier, Concrete Barrier and Terminal Sections; Various Types.** The unit price bid per foot for the above work shall include the cost of all labor, equipment and material necessary to complete the work, including the cost of any repairs required, and the costs of bending any rail element to the required curvature.

Payment for corrugated guide rail and median barrier, or bent box beam guide rail, will be determined using the payment factors for the various typical post spacings listed in Table 606-2. Payment will be the sum of the products obtained by multiplying the unit price bid for a rail or median barrier by the payment factors listed in Table 606-2 for the relevant post spacings and multiplying each of those products by the length of rail having that given post spacing.

Payment for mitered box beam and median barrier with 6 foot post spacings will be made at the unit prices bid. If a reduced post spacing of 3 feet is used for mitered box beam guide rail, the payment will be determined by multiplying the unit price bid by a payment factor of 1.1 for the length installed.

When posts are driven through asphalt concrete or bituminous treated material, any repairs to damage paved or treated areas shall be at the Contractor's expense. Progress payments will be made when the metal railing and/or metal barrier is erected in the position and manner indicated on the standard sheets and in a manner approved by the Engineer, exclusive of bituminous repair and final alignment. Payment will be made, at the unit price bid, for 90% of the measured quantity erected. The balance of the quantity

erected will be paid for upon proper repair to the bituminous surfaces and alignment of the metal railing and/or metal barrier to the specified tolerances.

**606-5.02 End Assembly, End Anchorage Units and Transitions for Guide Railing and Median Barrier.** The unit price bid for each end assembly, end anchorage unit or transition shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including the necessary concrete, excavation, backfill, reflectorization, object markers when required at driveways and vehicle openings, and spring cable assembly (compensating device) and/or steel turnbuckle cable end assembly required for cable guide rail.

**606-5.03 Resetting; Removing and Storing; Removing and Disposing; of Guide Railing, Median Barrier and Concrete Barrier.** The unit price bid per foot for the above work items shall include the cost of furnishing all labor, equipment and materials necessary to complete the work and restore the system to full operating capacity.

Any materials damaged due to Contractor's operation shall be replaced by him and the cost shall be included in the price bid for this item.

Payment for resetting guide rail and median barrier shall include the unit price bid multiplied by the measured quantity multiplied by the payment factor for the various typical post spacings listed in Table 606-2, except that posts required to reduce the post spacing from the original post spacing shall be paid for under the appropriate I-beam post for existing highway barrier item.

A. Progress payments for resetting guide rail, median barrier and precast concrete barrier will be made as follows:

1. 25% of the unit price bid for the quantity of guide rail, median barrier or precast concrete barrier removed and stored in accordance with the provisions of §606.3-06 Resetting Guide Railing, Median Barrier and Precast Concrete Barrier.
2. 65% of the unit price bid for the measured quantity of guide railing, median barrier or precast concrete barrier cleaned and reset in accordance with the provisions of §606-3.06.
3. The balance of the unit price bid for the quantity of the guide railing, median barrier or concrete barrier will be paid upon repair to the bituminous surfaces damaged by the resetting operations.

B. Progress payments for removing and disposing or storing of guide railing, median barrier or concrete barrier will be made as follows:

1. 75% of the unit price bid for the measured quantity of guide railing, median barrier or concrete barrier removed and stored or disposed of as specified.
2. The balance of the unit price bid for the measured quantity of guide railing and/or median barrier removed and stored or disposed of as specified will be paid when any voids have been backfilled and disturbed areas are reestablished to the satisfaction of the Engineer.

**606-5.04 Removing and Disposing of Guide Posts, Guide Rail Posts and Median Barrier Posts.** The unit price bid per post for the above work items shall include the cost of furnishing all labor, equipment and material necessary to complete the work.

**606-5.05 Resetting; Removing and Storing; Removing and Disposing; of Anchorage Unit Assemblies and End Assemblies for Guide Railing and Median Barrier.** The unit price bid for each of these items shall include the cost of furnishing all labor, equipment and material necessary to complete the work including excavation and backfill.

If the Contractor elects to install new concrete anchors, in lieu of removing and resetting the existing ones, the cost of furnishing and installing the new anchor as well as the cost for necessary adjustments to the existing one shall be included in the price bid for these items.



- A. Progress payments for resetting anchorage units and terminals for guide rail and median barrier will be made as follows:
1. 25% of the unit price bid for the quantity of anchorage units and/or terminals removed and stored in accordance with the provisions of §606-3.12 Resetting Anchorage Units and Terminals for Guide Rail and Median Barrier.
  2. 65% of the unit price bid for the quantity of anchorage units and/or terminals cleaned and reset in accordance with the provisions of §606-3.12 Resetting Anchorage Units and Terminals for Guide Rail and Median Barrier.
  3. The balance of the unit bid price for the quantity of anchorage units reset upon the reestablishment of surface areas disturbed.
- B. Progress payments for removing and storing or removing and disposing of anchorage units and/or terminals for guide railing and/or median barriers will be made as follows:
1. 75% of the unit price bid for the quantity of anchorage units and/or terminals removed and stored or disposed of as specified.
  2. The balance of the unit price bid for the quantity of anchorage units and/or terminals removed and stored or disposed of as specified will be paid upon the establishment of surface areas disturbed.

**606-5.06 Vacant 606-5.07 Corrugated Beam Guide Rail Transition to Bridge Rail, Concrete Barrier and Concrete Parapets.** The unit price bid per guide rail transition shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including back-up posts, connections and hardware.

**606-5.08 Box Beam Guide Rail Transition to Concrete Barrier.** The unit price bid per guide rail transition shall include the cost of all labor, equipment, and material necessary to satisfactorily complete the work, including back-up posts, necessary rail curvature, splices, connections and hardware.

**606-5.09 Vacant**

**606-5.10 I-Beam Posts for Existing Highway Barrier.** The unit price bid for I-beam posts for existing highway barrier shall include the cost of furnishing all labor equipment and material necessary to complete the work. Removal of damaged posts and hardware is included in other items of work.

When posts are driven through asphalt concrete or bituminous treated material, any repairs to damaged paved or treated areas shall be at the Contractor's expense.

**606-5.11 Retensioning Existing Gable Guide Railing and Median Barrier.** The unit price bid for retensioning a section of cable guide railing or median barrier shall include the cost of all labor, materials and equipment necessary to complete the work.

**606-5.12 Transition between Concrete Sections.** The unit price bid per concrete transition shall include the cost of all labor, equipment, and material necessary to satisfactorily complete the work, including back-up posts, connections and hardware.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
606.01	Cable Guide Railing	Foot
606.0101	Cable Guide Railing With Extra Long Posts	Foot
606.0201	Anchorage Units for Cable Guide Railing	Each
606.03	Cable Median Barrier	Foot
606.0310	Anchorage Units for Cable Median Barrier	Each
606.10	Box Beam Guide Railing	Foot

606.100002	Box Beam Guide Railing (Shop Bent or Shop Mitered)	Foot
606.100003	Box Beam Guide Railing (Shop Mitered)	Foot
606.1001	Box Beam Guide Railing With Extra Long Posts	Foot
606.100102	Box Beam Guide Railing with Extra Long Posts (Shop Bent or Shop Mitered)	Foot
606.100103	Box Beam Guide Railing with Extra Long Posts (Shop Mitered)	Foot
606.11	Box Beam Median Barrier	Foot
606.110002	Box Beam Median Barrier (Shop Bent or Shop Mitered)	Foot
606.110003	Box Beam Median Barrier (Shop Mitered)	Foot
606.120101	Box Beam End Piece	Each
606.120102	Box Beam Guide Railing End Assembly Type I	Each
606.120103	Box Beam Guide Railing End Assembly Type I with 18 ft Extension	Each
606.120201	Box Beam Guide Railing End Assembly Type IIA	Each
606.1203	Box Beam End Assembly Type III	Each
606.1401	Box Beam Median Barrier End Assembly, Type A	Each
606.1402	Box Beam Median Barrier End Assembly, Type B	Each
606.1403	Box Beam Median Barrier End Assembly, Type C	Each
606.17	Corrugated Beam Median Barrier	Foot
606.170001	Corrugated Beam Median Barrier (Shop Curved)	Foot
606.18	Weak-Post, Corrugated Beam Guide Rail	Foot
606.180001	Weak-Post, Corrugated Beam Guide Rail (Shop Curved)	Foot
606.1801	Weak-Post, Corrugated Beam Guide Rail With Extra Long Posts	Foot
606.180101	Weak-Post, Corrugated Beam Guide Rail With Extra Long Posts (Shop Curved)	Foot
606.22	Anchorage Units for Corrugated Beam Guide Railing	Each
606.2201	Anchorage Units for Corrugated Beam Guide Railing Buried In Back Slope	Each
606.23	Anchorage Units for Corrugated Beam Guide Railing (Driveways, Walkways, and Other Openings)	Each
606.24	Anchorage Units for Corrugated Beam Median Barrier	Each
606.26	Corrugated Beam Guide Railing End Terminal (Energy-Absorbing)	Each
606.27	HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing) Each	Each
606.2701	HPBO (Mod.) Corrugated Beam Guide Railing	Foot
606.270101	HPBO (Mod.) Corrugated Beam Guide Railing (Shop Curved)	Foot
606.2702	HPBO (Mod.) Corrugated Beam Guide Railing with Extra Long Posts	Foot
606.270201	HPBO (Mod.) Corrugated Beam Guide Railing with Extra Long Posts (Shop Curved)	Foot
606.2703	Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing	Each
606.2704	Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing Buried in Back Slope	Each
606.28	HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing) Each	Each
606.2801	HPBO (Mod.) Corrugated Beam Median Barrier	Foot
606.280101	HPBO (Mod.) Corrugated Beam Median Barrier (Shop Curved)	Foot
606.2802	Anchorage Units for HPBO (Mod.) Corrugated Beam Median Barrier	Each
606.3001	Concrete Barrier Type A (Optional)	Foot
606.3002	Concrete Barrier Type B (Optional)	Foot
606.3003	Concrete Barrier Type C (Optional)	Foot
606.3004	Half Section Concrete Barrier (Optional)	Foot

606.3005	Concrete Barrier - Mounting Block Section	Each
606.3011	Concrete Barrier Type A (Precast)	Foot
606.3012	Concrete Barrier Type B (Precast)	Foot
606.3013	Concrete Barrier Type C (Precast)	Foot
606.3014	Half Section Concrete Barrier (Precast)	Foot
606.3021	Concrete Barrier Type A (Cast-in-Place)	Foot
606.3022	Concrete Barrier Type B (Cast-in Place)	Foot
606.3023	Concrete Barrier Type C (Cast-in Place)	Foot
606.3024	Half Section Concrete Barrier (Cast-in Place)	Foot
606.3031	Concrete Barrier Type A (Machine Formed)	Foot
606.3032	Concrete Barrier Type B (Machine Formed)	Foot
606.3033	Concrete Barrier Type C (Machine Formed)	Foot
606.3034	Half Section Barrier (Machined Formed)	Foot
606.3041	Single-Slope Concrete Median Barrier (Optional)	Foot
606.3042	Single-Slope Concrete Median Barrier (Precast)	Foot
606.3043	Single-Slope Concrete Median Barrier (Cast-in-Place)	Foot
606.3044	Single-Slope Concrete Median Barrier (Machine Formed)	Foot
606.3051	Single-Slope Concrete Median Barrier - Wide (Optional)	Foot
606.3052	Single-Slope Concrete Median Barrier - Wide (Precast)	Foot
606.3053	Single-Slope Concrete Median Barrier - Wide (Cast-in-Place)	Foot
606.3054	Single-Slope Concrete Median Barrier - Wide (Machine Formed)	Foot
606.3061	Single-Slope Concrete Half Section Barrier (Optional)	Foot
606.3062	Single-Slope Concrete Half Section Barrier (Precast)	Foot
606.3063	Single-Slope Concrete Half Section Barrier (Cast-in-Place)	Foot
606.3064	Single-Slope Concrete Half Section Barrier (Machine Formed)	Foot
606.4701	I-Beam Posts for Existing Cable Median Barrier	Each
606.48	Retensioning Existing Cable Guide railing or Median Barrier	Each
606.4801	I-Beam Posts for Existing Cable Guide Railing	Each
606.4803	Extra Long I-Beam Posts for Existing Cable Guide Railing	Each
606.4805	I-Beam Posts for Existing Corrugated Beam Guide Railing	Each
606.4807	Extra Long I-Beam Posts for Existing Corrugated Beam Guide Railing	Each
606.4809	I-Beam Posts for Existing Box Beam Guide Railing	Each
606.4811	Extra Long I-Beam Posts for Existing Box Beam Guide Railing	Each
606.4813	I-Beam Posts for Existing Corrugated Beam Median Barrier	Each
606.4815	I-Beam Posts for Existing Box Beam Median Barrier	Each
606.4818	I-Beam posts for Existing HPBO (Mod.) Corrugated Beam Guide Railing	Each
606.4820	Extra Long I-Beam Posts for Existing HPBO (Mod.)Corrugated Beam Guide Railing	Each
606.4822	I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Median Barrier	Each
606.4824	Extra Long I-Beam Posts for Existing HPBO (Mod.) Corrugated Beam Median Barrier	Each
606.50	Resetting Cable Guide Railing	Foot
606.5010	Resetting Cable Median Barrier	Foot
606.5048	Resetting Cable Guide Railing (New Posts)	Foot
606.5049	Resetting Cable Median Barrier (New Posts)	Foot
606.51	Resetting Corrugated Beam Guide Railing	Foot
606.5148	Resetting Corrugated Beam Guide Railing (New Posts)	Foot
606.52	Resetting Corrugated Beam Median Barrier	Foot
606.5248	Resetting Corrugated Beam Median Barrier (New Posts)	Foot
606.53	Resetting Box Beam Guide Railing	Foot
606.5348	Resetting Box Beam Guide Railing (New Posts)	Foot

606.54	Resetting Box Beam Median Barrier	Foot
606.5448	Resetting Box Beam Median Barrier (New Posts)	Foot
606.5501	Resetting HPBO Corrugated Beam Guide Railing (New 12 in. Blockouts)	Foot
606.5601	Resetting HPBO Corrugated Beam Median Barrier (New 12 in. Blockouts)	Foot
606.57	Resetting Precast Concrete Barrier	Foot
606.5710	Resetting Precast Concrete Barrier- Half Section	Foot
606.58	Resetting HPBO (Mod.) Corrugated Beam Guide Railing	Foot
606.5801	Resetting HPBO (Mod.) Corrugated Beam Guide Railing (New Posts)	Foot
606.5810	Resetting HPBO (Mod.) Corrugated Beam Median Barrier	Foot
606.581001	Resetting HPBO (Mod.) Corrugated Beam Median Barrier (New Posts)	Foot
606.5901	Resetting Anchorage Units for Cable Guide railing or Median Barrier	Each
606.5910	Resetting Anchorage Units for Corrugated Beam Guide Railing or Median Barrier	Each
606.5920	Resetting Box Beam Guide Rail Turned-Down Terminal	Each
606.5921	Resetting Box Beam Guide Rail Energy-Absorbing Terminal	Each
606.5930	Resetting Box Beam Median Barrier End Assembly--Type A	Each
606.5931	Resetting Box Beam Median Barrier End Assembly--Type B	Each
606.5941	Resetting Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing	Each
606.5946	Resetting Anchorage Units for HPBO (Mod.) Corrugated Beam Median Barrier	Each
606.60	Removing and Storing Cable Guide Railing	Foot
606.6010	Removing and Storing Cable Median Barrier	Foot
606.61	Removing and Storing Corrugated Beam Guide Railing	Foot
606.62	Removing and Storing Corrugated Beam Median Barrier	Foot
606.63	Removing and Storing Box Beam Guide Railing	Foot
606.64	Removing and Storing Box Beam Median Barrier	Foot
606.65	Removing and Storing Precast Concrete Barrier	Foot
606.6510	Removing and Storing Precast Concrete Barrier-Half Section	Foot
606.66	Removing and Storing HPBO (Mod.) Corrugated Beam Guide Railing	Foot
606.67	Removing and Storing HPBO (Mod.) Corrugated Beam Median Barrier	Foot
606.6910	Removing and Storing Anchorage Units for Corrugated Beam Guide Railing and Median Barriers	Each
606.6911	Removing and Storing Weak- and Heavy-Post Corrugated Beam Terminals	Each
606.6920	Removing and Storing Box Beam Guide Railing End Assembly	Each
606.6932	Removing and Storing Box Beam Median Barrier End Assembly-Type C	Each
606.6941	Removing and Storing Anchorage Units for HPBO (Mod.) Corrugated Beam Guide Railing	Each
606.6946	Removing and Storing Anchorage Units for HPBO(Mod) Corrugated Beam Median Barrier	Each
606.70	Removing and Disposing Cable Guide Railing	Foot
606.7010	Removing and Disposing Cable Median Barrier	Foot
606.71	Removing and Disposing Corrugated Beam Guide Railing	Foot
606.7101	Removing and Disposing HPBO (Mod.) Corrugated Beam Guide Railing	Foot
606.72	Removing and Disposing Corrugated Beam Median Barrier	Foot
606.7201	Removing and Disposing HPBO (Mod.) Corrugated Beam Median Barrier	Foot
606.73	Removing and Disposing Box Beam Guide Railing	Foot
606.74	Removing and Disposing Box Beam Median Barrier	Foot
606.75	Removing and Disposing Concrete Barrier	Foot

606.7510	Removing and Disposing Concrete Barrier-Half Section	Foot
606.76	Removing and Disposing of Guide Posts, Guide Rail Posts, and Median Barrier Posts	Each
606.79	Removing and Disposing Anchorage Units for Cable Guide railing or Median Barrier	Each
606.7910	Removing and Disposing Anchorage Units for Corrugated Beam Guide Railing and Median Barrier	Each
606.7911	Removing and Disposing Weak- and Heavy-Post Corrugated Beam Energy-Absorbing Terminals	Each
606.7920	Removing and Disposing Box Beam Guide Rail Turned-Down Terminal	Each
606.7921	Removing and Disposing Box Beam Energy-Absorbing Terminal	Each
606.7930	Removing and Disposing Box Beam Median Barrier End Assembly-Type A	Each
606.7931	Removing and Disposing Box Beam Median Barrier End Assembly--Type B	Each
606.7932	Removing and Disposing Box Beam Median Barrier End Assembly-Type C	Each
606.7941	Removing and Disposing Anchorage Units for HPBO(Mod) Corrugated Beam Guide Railing	Each
606.7946	Removing and Disposing Anchorage Units for HPBO(Mod) Corrugated Beam Median Barrier	Each
606.8101	Guide Rail Transition Weak-Post Corrugated Beam to Box Beam Guide Rail (One or Two Way Operation)	Each
606.8201	Guide Rail Transition Box Beam to Weak-Post Corrugated Beam Guide Rail (One Way Only)	Each
606.83	Guide Rail Transition Cable to Box Beam (One or Two Way Operation)	Each
606.84	Guide Rail Transition Box Beam to Cable (One Way Only)	Each
606.8501	Median Barrier Transition Weak-Post Corrugated Beam to Box Beam	Each
606.86	Guide Rail Transition Corrugated Beam to Thrie Beam	Each
606.8701	Corrugated Beam Guide Railing Transition Assembly Two Rail Steel Bridge Railing	Each
606.8702	Corrugated Beam Guide Railing Transition Assembly Four Rail Steel Bridge Railing	Each
606.8703	Corrugated Beam Guide Railing Transition Assembly Discontinuous Steel Bridge Railing	Each
606.8704	Corrugated Beam Guide Railing Transition Assembly Concrete Parapets, or Concrete Barrier	Each
608.8801	Transition from Box Beam Guide Rail to Jersey-shaped Concrete Barrier (One- or Two-Way Operation)	Each
608.8802	Transition from Jersey-shaped Concrete Barrier to Box Beam Guide Rail (One Way - Trailing End of Barrier)	Each
606.8803	Transition Between Box Beam Guide Rail and Single Slope Half Section Concrete Barrier (One or Two Way Operation)	Each
606.8804	Transition Between Single Slope Half Section Concrete Barrier and Box Beam Guide Rail (One Way - Trailing End of Barrier)	Each
606.8805	Transition Between Box Beam Median Barrier and Single Slope Concrete Median Barrier	Each
606.8806	Transition from Box Beam Guide Rail to Full-Section Single-Slope Concrete Barrier (One- or Two-Way Operation)	Each
606.8807	Transition from Full-Section Single-Slope Concrete Barrier to Box Beam Guide Rail (One Way - Trailing End of Barrier)	Each
606.8901	Transition: HPBO (Mod.) Corrugated Guide Railing to	

	Beam Box Beam Guide Railing	Each
606.8902	Transition: HPBO (Mod.) Corrugated Beam Guide Railing to Weak Post Corrugated Beam Guide Railing	Each
606.8903	Transition: HPBO (Mod.) Corrugated Beam Guide Railing to Single Slope Concrete Half Section Barrier	Each
606.8904	Transition: HPBO (Mod.) Corrugated Beam Median Barrier to Beam Box Beam Median Barrier	Each
606.8905	Transition: HPBO (Mod.) Corrugated Beam Median Barrier to Weak Post Corrugated Beam Median Barrier	Each
606.8906	Transition: HPBO (Mod.) Corrugated Beam Median Barrier to Single Slope Concrete Median Barrier	Each
606.9001	Transition between Standard (NJ) Concrete Barrier and Single-Slope Concrete Barrier	Each
606.9002	Transition between Wide and Normal Single Slope Concrete Median Barrier	Each
606.9003	Transition between Half-Section and Full-Section Single Slope Concrete Barrier (Left Pocket)	Each
606.9004	Transition between Half-Section and Full-Section Single Slope Concrete Barrier (Right Pocket)	Each

## SECTION 607 - FENCES

**607-1 DESCRIPTION.** This work shall consist of furnishing and erecting fencing and metal fence gates of the type and size, and at the locations shown on the plans or as directed by the Engineer. Construction of fencing and gates shall be done in accordance with the specifications, the standard sheets, and the plans, and in reasonable close conformity with the lines and grades shown on the plans or established by the Engineer.

**607-1.01 Fence Types.** The fence shall be designated as follows:

Optional Chain Link Fence Type I  
Optional Chain Link Fence Type II  
Vinyl Coated Chain Link Fence on Plastic Coated Frame  
Right-of-Way Fencing

The options for Type I and Type II chain link fences shall be as follows:

### TYPE I

#### Fabric Options

Coated Steel Fence Fabric  
(95% Zinc 5% Aluminum- Mischmetal Alloy)  
Galvanized Steel  
Aluminum  
Aluminum Coated Steel

#### Frame Options

Mischmetal Alloy Coating  
(95% Zinc 5% Aluminum)  
Galvanized Steel  
Combined Coating on Steel  
Aluminum  
Aluminum Coated Steel

### TYPE II

#### Fabric Options

Coated Steel Fence Fabric  
(95% Zinc 5% Aluminum- Mischmetal Alloy)

#### Frame Options

Mischmetal Alloy Coating  
(95% Zinc 5% Aluminum)

Galvanized Steel  
Vinyl Coated Steel  
Aluminum  
Aluminum Coated Steel

Galvanized Steel  
Combined Coating on Steel  
Plastic on Steel  
Aluminum  
Aluminum Coated Steel

Fence gates for Type I and Type II optional fences shall be consistent with the fabric and frame option selected for the contract. Fence frame and fabric selected shall be consistent throughout the contract except where intermixing is permitted by the Engineer.

**607-2 MATERIALS.** Materials shall conform to the requirements specified in the following subsections of Section 700 - Materials and Manufacturing:

Zinc Chromate Primer	708-04
Aluminum Fence Fabric	710-01
Galvanized Steel Fence Fabric	710-02
Vinyl Coated Steel Fence Fabric	710-03
Aluminum Coated Steel Fence Fabric	710-04
Coated Steel Fence Fabric (95% Zinc 5% Aluminum-Mischmetal Alloy)	710-05
Steel and Iron Posts, Rails, Braces and Fittings for Chain-Link Fence	710-10
Aluminum Posts, Rails, Braces and Fittings for Chain-Link Fence	710-11
Plastic Coated Posts, Rails, Braces and Fittings for Chain-Link Fence	710-12
Right-of-Way Fencing	710-30

**607-2.01 Portland Cement Concrete for Bases.** Portland Cement concrete used for bases shall be Class A or C conforming to the requirements of Section 501 Portland Cement Concrete--General except that requirements for automated batching shall not apply.

**607-2.02 Right-of-Way Fencing.** The Contractor has the option of using posts and braces fabricated from either high carbon shapes of steel or pressure treated wood meeting the requirements of §710-30 Right-of-Way Fencing.

**607-2.03 Fence Gates.** Fence gates for Right-of-Way Fencing shall Conform to the requirements for Right-of-Way Fence Gates of §710-30. Fence gates for Chain-Link Fence shall conform to the following:

**A. Gate Frames.** Frames shall be constructed of tubular members welded at all corners or assembled with corner fittings. Where corner fittings are used gates shall have 3/8 inch nominal diameter truss rods to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 8 feet apart. Gate leaves over 10 feet long shall have a horizontal brace or a 3/8 inch nominal diameter diagonal truss rod. Gate leaves over 16 feet shall have both a horizontal brace and a 3/8 inch nominal diameter truss rod.

**B. Gate Fabric.** Gate fabric shall conform to the requirements of the fabric used in the fence construction.

**C. Gate Hinges.** Hinges shall be weldable steel, cast steel or malleable iron 180° offset industrial type. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of

being opened and closed easily by one person. Hinges shall be galvanized in accordance with §719-01 Type I.

**D. Gate Latches.** Latches, stops and keepers shall be provided for all gates. Latches shall have a plungerbar arranged to engage the center stop, except that single left gate openings with an opening of less than 10 feet may use a forked latch. Latches shall be arranged for locking and the Contractor shall provide a lock with triplicate keys for each gate. Center stops shall consist of a device arranged to be set in concrete and to engage a plunger-bar of the latch of double leaf gates. No stop is required for single leaf gates. Keepers shall consist of a mechanical device for securing the free end of the gate when in the full open position.

### **607-3 CONSTRUCTION DETAILS**

**607-3.01 General.** The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of closure indicated.

When the plans require that the posts, braces, or anchors be embedded in concrete, the Contractor shall install temporary guys or braces as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys and bracing set in concrete until seven days have elapsed from the time of placing the concrete.

All posts shall be set vertically and to the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the Engineer and under the Engineer's specified conditions.

Wire or fencing of the size and type required shall be firmly attached to the posts and braces in the manner indicated. All wire shall be stretched taut and be installed to the required elevations.

At each location where an electric transmission, distribution or secondary line crosses any of the types of fences covered by these specifications, the Contractor shall furnish and install a ground conforming to the requirements of Subsection 9 of the National Electric Safety Code.

Fence shall generally follow the contour of the ground, with the bottom of fence fabric no less than 1 inch nor more than 6 inch from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

Line posts shall be spaced equidistant in the fence line at the spacing shown on the plans, standard sheets or as directed by the Engineer. End, corner, and intermediate posts shall be placed at the locations indicated on the plans, standard sheets or as directed by the Engineer, and shall be braced as shown on the plans or standard sheets. When chain link fence is on a long curve intermediate posts shall be evenly spaced so that the strain of the fence will not bend the line posts.

All end, corner, and intermediate posts shall be set plumb in concrete bases of the depth and diameter shown on the plans or standard sheets. The Contractor shall have the option of setting the line posts in concrete bases or using methods of driving and anchoring specified by the fence manufacturer and approved by the Engineer.

The concrete bases shall be rough cast in the ground around the posts. The top surfaces shall be domed to shed water and provide a neat workmanlike appearance when completed. Extensions of up 45 minutes for the allowed time for pouring the concrete will be permitted.

**607-3.02 Chain-Link Fencing with Top Rail.** Posts shall be set so they are equidistant with a maximum of 10 foot centers.

All top rails shall pass through the base of the post caps and shall form a continuous brace from end to end of each stretch of fence. Top rail lengths shall be joined with sleeve couplings with expansion



sleeves provided at 100 foot intervals. Top rails shall be securely fastened to end posts by means of approved rail end connectors. Horizontal braces shall be provided at all intermediate posts, midway between the top rail and ground as shown on the plans or standard sheets.

Diagonal truss rods shall be installed with the horizontal braces as indicated on the plans or standard sheets.

Fence fabric shall be installed approximately 2 inch above the ground level and securely fastened along the bottom, and to all braces, top rails, line and pull posts, at the intervals indicated on the standard sheets by approved methods. The fabric shall be secured to all end, corner and gate posts with stretcher bars fastened to the posts, with stretcher bands spaced at a maximum of 14 inches and in a manner permitting adjustment of the fabric tension.

If the Contractor elects the option of using one piece roll-formed sections, the fence fabric shall be integrally woven into the fabric loops on the end, corner, pull and gate posts. The fabric shall be attached to the top braces and line posts as shown on the standard sheets.

**607-3.03 Chain-Link Fencing with Top Tension Wire.** The construction details specified in §607-3.02 Chain Link Fencing with Top Rail shall apply with the following modifications:

- A. Top tension wire shall be installed as shown on the plans, standard sheets, or as directed by the Engineer.
- B. All posts shall be spaced equidistant in the fence line on a maximum of 8 foot centers.
- C. Additional pull posts shall be placed at locations indicated on the plans or standard sheets. Brace assemblies shall be installed at each intermediate post as indicated on the plans or standard sheets.

**607-3.04 Vinyl Coated Chain-Link Fencing on Plastic Coated Frame.** The construction details specified in §607-3.02 Chain-Link Fencing with Top Rail or §607-3.03 Chain-Link Fencing with Top Tension Wire shall apply with the following addition:

If any of the resin clad material specified under this item has the protective resin coating damaged so its effectiveness to prevent corrosion of the base material is impaired, the Contractor shall repair such parts by applying one coat of an approved compound of a color to match original material.

**607-3.05 Aluminum Posts.** Aluminum posts shall be set in accordance with requirements pertaining to fence posts of §607-3.01 General, and §607-3.02 Chain-Link Fencing with Top Rail or §607-3.03 Chain-Link Fencing with Top Tension Wire and with the following additional requirement: The portions of aluminum posts that will be in contact with the concrete bases shall be coated with Zinc Chromate Primer conforming to the requirements of §708-04. The primer shall be thoroughly dry before setting of the post in the concrete.

**607-3.06 Right-of-Way.** Fencing posts shall be set plumb and firm to the satisfaction of the Engineer in properly prepared post holes, as indicated on the plans or standard sheet. The concrete for post holes where required shall be placed in accordance with the requirements of §607-3.01 General.

All line posts of the type and size shown on the plans or standard sheets shall be placed equidistant in the fence line. Wood line posts shall be placed on a maximum of 15 foot centers and metal line posts shall be placed on a maximum of 10 foot centers.

Intermediate posts and post assemblies, end posts, corner posts, approach spans, and bracing shall be as shown on the plans or standard sheets.

The woven wire fencing shall be fastened to all steel line posts with at least 5 galvanized wire fasteners or clamps and to all steel end, intermediate and corner posts with aluminum wire not less than 5/32 inch diameter.

The woven wire fencing shall be fastened to all wood posts with either 1 1/2 inch galvanized or aluminum staples. The top and bottom wires and every other in-between wires shall be stapled, alternating the stapling of the in-between wires on successive posts.

**607-3.07 Fence Gates.** The Contractor shall construct metal fence gates of the type and size as indicated on the plans or standard sheets, and in the location shown or ordered by the Engineer.

**607-4 METHOD OF MEASUREMENT**

**607-4.01 General.** The quantity to be paid for all fencing exclusive of fence gates and fencing of the types listed in subsequent subsections, will be the number of linear feet of chain-link fencing measured along the top of fencing, center to center of end posts, properly furnished and installed in accordance with the plans, specifications, standard sheets and directions of the Engineer. An allowance of 10 feet will be added for each end post, corner post and pull post installed in accordance with the plans, specifications, standard sheets and directions of the Engineer.

**607-4.02 Right-of-Way Fencing.** Right-of-Way Fencing shall be measured as the number of feet along the top of the fencing from center to center of the end posts, properly furnished and installed in accordance with the plans, specifications, standard sheets and directions of the Engineer. An allowance of 20 feet will be added for each end post, corner post, intermediate post, and approach post installed in accordance with the plans, specifications, standard sheets and directions of the Engineer.

**607-4.03 Fence Gates.** Fence gates shall be measured as the number of complete gates furnished and erected in accordance with the specifications, plans, standard sheets and directions of the Engineer.

**607-5 BASIS OF PAYMENT**

**607-5.01 General.** The unit price bid per linear foot of fencing shall include the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work.

**607-5.02 Fence Gates.** The unit price bid for each size gate shall cover the cost of furnishing all labor, materials, tools and equipment necessary to satisfactorily complete the work and shall include all necessary clearing, grubbing, excavation and disposal, fill, concrete, gates, gate posts, lock, bracing and all other necessary materials.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
607.051X	Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame with Top Rail	Foot
607.052X	Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame with Top Tension Wire	Foot
607.16xx	Fence Gate with Vinyl Coated Steel Chain-Link Fencing on Plastic Coated Frame	Each
607.19	Right-of Way Fencing	Foot
607.20xx	Right-of Way Fence Gates	Each
607.30xx	Optional Chain-Link Fence, Type I, with Top Rail	Foot
607.31xx	Optional Chain-Link Fence, Type I, with Top Tension Wire	Foot
607.32xx	Optional Chain-Link Fence, Type II, with Top Rail	Foot
607.33xx	Optional Chain-Link Fence, Type II with Top Tension Wire	Foot
607.40xx	Optional Fence Gates	Each

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

**SECTION 608 - SIDEWALKS, DRIVEWAYS, BICYCLE PATHS, AND VEGETATION CONTROL STRIPS**

(Last Revised September, 2021)

**608-1 DESCRIPTION.** This work shall consist of the construction of portland cement concrete or hot mix asphalt sidewalks and driveways; hot mix asphalt bicycle paths and vegetation control strips; precast concrete paving, brick paving, grouted stone block paving, and detectable warnings on pedestrian facilities in accordance the contract documents and as directed by the Engineer.

**608-2 MATERIALS.** Provide materials meeting the requirements specified in the following subsections of Section 700 - *Materials and Manufacturing*:

Portland Cement	701-01
Bituminous Materials	702-00
Fine Aggregates	703-01
Coarse Aggregates	703-02
Mortar Sand	703-03
Cushion Sand	703-06
Concrete Sand	703-07
Mineral Filler	703-08
Brick Sidewalk and Driveway Pavers	704-08
Stone Blocks	704-09
Precast Concrete Driveway and Sidewalk Pavers	704-13
Caulking Compound for Structures	705-06
Premolded Resilient Joint Filler	705-07
Masonry Mortar	705-21
Wire Fabric for Concrete Reinforcement	709-02
Fibers for Concrete Reinforcement	711-01
Membrane Curing Compound	711-05
Form Insulating Materials for Winter Concrete	711-07
Admixtures	711-08
Water	712-01
Surface-applied Detectable Warning Units	726-01
Embedded Detectable Warning Units	726-02

#### **608-2.01 Portland Cement Concrete Sidewalks and Driveways.**

**A. Conventionally Formed Sidewalks and Driveways.** Provide concrete meeting the requirements for Class D in accordance with Section 501 *Portland Cement Concrete-General*. Provide concrete that contains an ASTM Type A water-reducing admixture meeting the requirements of §711-08 *Admixtures* and provides a minimum of 10% reduction of the design water content from the target mix design for Class D.

**B. Machine Formed Sidewalks.** Provide concrete meeting the requirements for Class J in accordance with Section 501 *Portland Cement Concrete-General* with the exception that the mix incorporates fibers for concrete reinforcement meeting the requirements of §711-01 *Fibers for Concrete Reinforcement*.

**C. Accelerated Cure Sidewalks and Driveways.** Submit a concrete mix design that achieves a compressive strength of 2,000 psi in less than 24 hours to the Materials Bureau for approval a minimum

of 14 days prior to starting the work. Supply test data indicating that the concrete mix will have a scaling rating of one or less when tested in accordance with ASTM C672.

**D. Reinforcement.** Provide welded wire fabric reinforcement made of W2.9 or W3 wire at 6 inch centers transversely and longitudinally meeting the requirements of §709-02 *Wire Fabric for Concrete Reinforcement*. Provide fiber reinforcement meeting the requirements of §711-01 *Fibers for Concrete Reinforcement*. Add fiber reinforcement during batching at a rate of 1.5 pounds of fibers per cubic yard of concrete, using a method approved by the Regional Materials Engineer. Batch a volume of concrete such that whole standard size bags or packages of fibers are used. Indicate on each delivery ticket the amount of fibers added to the concrete.

**608-2.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips.** Provide a 9.5 mixture for surface course or 19.0 mixture for any course below the surface designed for < 0.3 million ESALs and produced in accordance with Section 401 using coarse aggregate Type F9. Use a PG 64S-22 binder to produce the hot mix asphalt. Alternate PG binder grades may be allowed with the approval of the Regional Materials Engineer.

Do not use polyphosphoric acid (PPA) downstate to modify the PG binder properties for mixtures containing limestone, limestone as an aggregate blend component, limestone as a constituent in crushed gravel aggregate, or recycled asphalt pavement (RAP) that includes any limestone. Do not use PPA downstate as a cross-linking agent for polymer modification of mixtures containing limestone, limestone as an aggregate blend component, limestone as a constituent in crushed gravel aggregate, or recycled asphalt pavement (RAP) that includes any limestone. Downstate, as it relates to PG binder is defined as Orange, Putnam, Rockland, Westchester, Nassau, Suffolk Counties and the City of New York.

Do not use polyphosphoric acid (PPA) upstate to modify the PG binder properties or as a cross-linking agent for polymer modification, regardless of the type of aggregate. Upstate is defined as all counties not designated as downstate.

**608-2.03 Brick Paved Sidewalks and Driveways.** Provide brick pavers meeting the requirements of §704-08 *Brick Pavers*, of the size, shape and color specified in the contract documents.

**A. Sand Setting Bed.** Provide sand for setting bed meet the requirements of §703-06 *Cushion Sand*.

**B. Mortar Setting Bed.** Provide mortar for setting bed meeting the requirements of §705-21 *Masonry Mortar*.

**C. Bituminous Setting Bed.** Provide hot mix asphalt for bituminous setting bed consisting of PG 64S-22 binder mixed with fine aggregate. Use PG binder meeting the requirements of Section 702 *Bituminous Materials*, Table 702-1 *Performance-Graded Binders for Paving*. Use a minimum of 7.0% PGB by batch weight. Alternate PG binder grades may be allowed with the approval of the Regional Materials Engineer. Heat the mix to approximately 325°F.

Provide neoprene-modified asphalt adhesive consisting of 2% neoprene, grade WM1, oxidized asphalt with an R & B softening point of 155°F minimum and a penetration of 80, and 10% asbestos-free fibers.

**D. Sand-Cement Setting Bed.** Provide sand-cement mixture for setting bed consisting of 1 part Portland Cement Type 2 and 6 parts Fine Aggregate, by volume.

**608-2.04 Grouted Stone Block Paved Sidewalks and Driveways.** Provide stone blocks meeting the requirements of §704-09 *Stone Blocks* of the size, shape and color specified in the contract documents.

**A. Sand Setting Bed.** Provide sand for setting bed meet the requirements of §703-06 *Cushion Sand*.

**B. Mortar Setting Bed.** Provide mortar for setting bed meeting the requirements of §705-21 *Masonry Mortar*.

**C. Sand-Cement Setting Bed.** Provide sand-cement mixture for setting bed consisting of 1 part Portland Cement Type 2 and 6 parts Fine Aggregate, by volume.

**608-2.05 Precast Concrete Block Paved Sidewalks and Driveways.** Provide precast concrete driveway and sidewalk pavers meeting the requirements of §704-13 *Precast Concrete Driveway and Sidewalk Pavers* of the size, shape and color specified in the contract documents. Provide granular setting bed material consisting of hard, durable; uncoated particles of soil or rock, free from lumps of clay and all deleterious substances in accordance with Table 608-1 *Granular Material Setting Bed Gradation*.

TABLE 608-1 GRANULAR MATERIAL SETTING BED GRADATION	
Sieve Size	Percent Passing by Weight
1/4 inch	100
# 10	50-85
# 40	20-45
# 200	3-10

**608-2.06 Surface-Applied Detectable Warning Units.** Provide surface-applied detectable warning units meeting the requirements of §726-01 *Surface-applied Detectable Warning Units* of the color specified in the contract documents. Provide setting bed material and/or surface preparation materials in accordance with the manufacturer’s recommendations.

**608-2.07 Embedded Detectable Warning Units.** Provide embedded detectable warning units meeting the requirements of §726-02 *Embedded Detectable Warning Units* of the color specified in the contract documents. Provide setting bed material and/or surface preparation materials in accordance with the manufacturer’s recommendations.

**608-3 CONSTRUCTION DETAILS.** Construct all pedestrian facilities in accordance with the requirements of the *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right Of Way (PROWAG)*. Not all facilities can be designed to meet the current PROWAG design standards. Features that do not meet PROWAG requirements must be approved by the Department and noted as non standard features in the contract documents. Chapter 2 of the NYSDOT Highway Design Manual provides direction. For facilities that cannot meet the current PROWAG design standards, construct facilities to meet the standards to the greatest extent practicable. Install all work in accordance with the Standard Sheets and the lines and grades shown in the contract documents. Dimensions shown on the Standard Sheets are the minimum values in order to be compliant with the PROWAG requirements and for acceptance of the work. Slopes shown on the Standard Sheets are maximum values for design and layout. Ensure constructed facilities do not have construction tolerances that result in work that does not meet the PROWAG requirements.

**608-3.01 Portland Cement Concrete Sidewalks and Driveways.** Install concrete sidewalks and driveways in accordance with Section 501 *Portland Cement Concrete- General* and the contract documents. Start concrete placement operations when the ambient air temperature is 40°F or higher, when measured in the shade, within an accuracy of ± 2°F. Discontinue placement if the ambient air temperature falls below 40°F. Ensure the surface temperature of the base material is 40°F or higher and that the surface does not have any snow, ice, frost, or standing water on it. Do not place concrete in the rain. Use insulating materials or heating equipment if necessary to prepare base material before placement begins. Form sidewalks and

driveways conventionally or by machine. Install a premolded resilient joint filler at all joints between sidewalk and curb, pavement, buildings, or other vertical surfaces, and at all transverse construction joints. Fill any transverse gaps from ½ inch to 1 inch in width with Caulking Compound for Structures.

Ensure workers installing pedestrian facilities are familiar with the requirements for those facilities under the *Americans with Disabilities Act*. Provide an American Concrete Institute (ACI) Certified Concrete Flatwork Technician to perform all finishing. When the contract includes 10 cubic yards or more of sidewalk and driveway concrete, provide an ACI Certified Concrete Flatwork Finisher to directly supervise all finishing. Provide proof of ACI flatwork certification to the Engineer prior to concrete placement.

**A. Conventionally Formed Sidewalks and Driveways.** Use concrete forms free from warp and that extend to the full depth of the sidewalk or driveway. Ensure forms are secured so no displacement will occur during the placement of concrete.

Use welded wire fabric or fiber reinforcement. At commercial driveways, use welded wire fabric for both the sidewalk and the driveway, additional fiber reinforcement will be allowed at the Contractor's option. When using wire fabric for concrete reinforcement, embed it at mid-depth in the slab.

Place the concrete in one course to the full depth shown in the contract documents. Immediately after placement of the concrete, thoroughly compact the concrete with internal mechanical vibrating equipment. Use internal mechanical vibrators that are adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. Insert the vibrating element vertically into the concrete mass at a depth sufficient to vibrate the entire depth, and then withdraw it completely from the concrete before advancing to the next point of application. Vibrate at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. Vibrate for a sufficient time duration to accomplish thorough consolidation and produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles. Work the concrete into all angles and corners of the forms, however, avoid over-vibration. Continue vibration in one place until the concrete has become uniformly plastic, but not to the extent that pools of laitance are formed. Supplement vibration by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Do not use vibrators to push or distribute the concrete laterally.

Use only hand screeding and finishing, do not use mechanical screeding or finishing equipment.

**B. Machine Formed Sidewalks.** Provide machine forming equipment consisting of a single self-propelled paver capable of placing, spreading, consolidating, screeding, and finishing the concrete such that hand finishing is kept to a minimum. Provide equipment guided by a reference system that ensures the pavement is placed to the specified line, grade, and cross section. Provide a paver equipped with rigid side forms that laterally support the concrete and minimize edge slumping, a full-width finishing pan, and attached internal vibrators capable of consolidating the entire concrete placement.

Apply the provisions of §569-3.05 E. *Central and Transit Mixed Concrete* to maintain desired slump during the concrete placement. Use fiber reinforcement only, do not use welded wire fabric reinforcement. Make water additions at the point of deposition in accordance with §569-3.05 E.

**C. Accelerated Cure Sidewalks and Driveways.** Use concrete forms free from warp and that extend to the full depth of the sidewalk or driveway. Ensure forms are secured so no displacement will occur during the placement of concrete. Use only conventional forming with welded wire fabric reinforcement embedded at mid-depth in the slab.

Place the concrete in one course to the full depth shown in the contract documents. Immediately after placement of the concrete, thoroughly compact the concrete with internal mechanical vibrating

equipment. Use internal mechanical vibrators that are adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. Insert the vibrating element vertically into the concrete mass at a depth sufficient to vibrate the entire depth, and then withdraw it completely from the concrete before advancing to the next point of application. Vibrate at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. Vibrate for a sufficient time duration to accomplish thorough consolidation and produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles. Work the concrete into all angles and corners of the forms, however, avoid over-vibration. Continue vibration in one place until the concrete has become uniformly plastic, but not to the extent that pools of laitance are formed. Supplement vibration by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Do not use vibrators to push or distribute the concrete laterally.

Use only hand screeding and finishing, do not use mechanical screeding or finishing equipment.

To reduce the time needed to reach the required opening compressive strength, cover the concrete with form insulating materials such that the concrete curing temperature reaches a minimum of 25°F above ambient air temperature. Secure the insulation tight to the concrete surface to prevent air intrusion beneath the insulation. Extend these materials a minimum of 12 inches beyond the edge of the concrete to prevent air intrusion beneath the insulation. Apply external heat meeting the requirements of §555-3.08C.2. *Provision of External Heat* to the concrete at the Contractor's option.

Cast compressive strength cylinders for determining strength gain at the time of placement. Keep these cylinders insulated with the placement. Break cylinders at times requested by the Contractor until the minimum compressive strength of 2,000 psi is reached. Submit requests for alternate means to determine concrete maturity by coordinating cylinder compressive strengths to concrete curing temperature a minimum of 60 days prior to placement for approval by the Director, Materials Bureau.

**D. Finishing.** Use only magnesium floats and finishing tools, do not use aluminum or steel. Finish the concrete to produce a smooth surface and then broom the surface to a uniform slip-resistant texture. Tool the edges and scored joints of all sidewalk slabs with an edging tool having a 1/4 inch radius.

Score and tool the concrete surface at intervals of 5 feet, a minimum 1/8 inch to a maximum 1/4 inch in width, and to a minimum depth of one-third the total thickness.

**E. Curing.** Immediately after finishing, and not more than 30 minutes after concrete placement, apply a clear membrane curing compound that includes a fugitive dye at a rate of 1 gallon per 150 square feet. Do not apply curing compound in the rain. If rain damages the curing compound before it sets, reapply curing compound promptly after the concrete surface dries.

Submit requests for alternate means to determine concrete maturity by coordinating cylinder compressive strengths to concrete curing temperature a minimum of 60 days prior to placement for approval by the Director, Materials Bureau. If the ambient air temperature is expected to fall below 40°F anytime during the curing period, provide a supply of form insulating materials capable of maintaining a surface temperature of 55°F at the work site sufficient to cover all concrete placed.

Cure all driveways and sidewalks at driveways for a minimum of 3 days prior to opening to vehicle traffic. Place form insulating materials as necessary to prevent the newly placed concrete from being exposed to ambient air temperatures at the concrete surface below 36°F during the curing period. Secure and overlap the form insulating materials tight to the concrete surface extending a minimum of 12 inches beyond the edge of the concrete to prevent air intrusion beneath the insulation. Maintain form insulating materials in place for the curing period. If the ambient air temperature falls below 40°F anytime during the curing period, cure conventionally formed sidewalks and driveways and machine formed sidewalks for a minimum of 6 days. If the concrete temperature falls below 32°F or the concrete is damaged by cold weather, remove and replace it at no additional cost to the State.

Place 4 equally spaced recording surface thermometers between the concrete surface and the insulating material and 12 inch from the outside edge of concrete for each day's placement. Do not subject the concrete to a temperature drop in excess of 50°F during the first 24 hours after removing the insulation.

If saw cutting is necessary, use diamond blade saws equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control capable of making straight cuts to the dimensions required.

**608-3.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips.** Install hot mix asphalt sidewalks, driveways, bicycle paths and vegetation control strips in accordance with the provisions Section 402 *Hot Mix Asphalt (HMA) Pavements*, the Standard Sheets, and the contract documents. Place the number of courses and course thicknesses in accordance with Table 608-2 *Hot Mix Asphalt Composition*. Place vegetation control strips using a 9.5 mix with a minimum thickness of 3 inches in one course. Compact hot mix asphalt in accordance with the requirements of §402-3.07D. *80 Series Compaction Method*.

TABLE 608-2 HOT MIX ASPHALT COMPOSITION			
Total Placed Thickness	9.5 Mix	19.0 Mix	Number of Courses
1 1/2 inch	1 1/2 inch		1
2 inch	2 inch		1
3 + inch	1 1/2 inch	1 1/2 + inch	2+

**NOTES:**

1. For the 19.0 mixture, place a maximum thickness of 3 inches in one pass.
2. A course consists of one or more separate lifts of a hot mix asphalt mixture to attain the indicated thickness.

**608-3.03 Brick Paved Sidewalks and Driveways.** Install brick pavers to the lines and grades and in the pattern shown in the contract documents to provide a uniform, even surface. Ensure joints between bricks are hand tight. Do not install or grout brick pavers in freezing weather. After installation, sweep a dry mixture of masonry mortar over the brick pavers until the joints are completely filled, and then lightly wet the joints with water. Clean brick pavers of excess mortar, and finish joints prior to the mortar setting up. Keep brick paving moist for 4 days after filling the joints with mortar. After the 4 day curing period, remove remaining mortar film using a light acid wash (10% solution of hydrochloric or muriatic acid) followed by flushing clean with water or as approved by the Engineer. Avoid the use of acid in areas where runoff could damage trees or other vegetation.

**A. Brick Paved Sidewalks and Driveways (Sand Setting Bed).** Lay brick pavers in a properly compacted 2 inch bed of cushion sand over the subbase or subgrade.

When used over tree pits, install bricks pavers in a 3 inch bed of cushion sand. After installation, sweep dry cushion sand over the brick pavers until the joints are completely filled. Do not use mortar to seal brick paver joints in tree pits.

**B. Brick Paved Sidewalks and Driveways (Mortar Setting Bed).** Lay brick pavers in a mortar setting bed, a minimum of 1 inch thick over the concrete or bituminous subbase.

**C. Brick Paved Sidewalks and Driveways (Bituminous Setting Bed).** Lay brick pavers in a 3/4 inch thick bituminous setting bed, over a concrete or bituminous subbase. Apply a coating of neoprene-modified asphalt adhesive by mopping, squeegeeing or troweling over the top surface of the bituminous setting bed to bond the bricks to the setting bed.



**D. Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed).** Lay brick pavers on a 2 inch thick setting bed of sand-cement over the subbase. Place the sand-cement setting bed not more than 4 hours prior to installing the brick pavers.

**E. Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed).** Install brick paver sidewalks and driveways using one of the following methods, at the Contractor's option:

1. Lay bricks on a setting bed of portland cement concrete while it is still fresh and firmly position bricks to provide a solid bedding under each brick.
2. Lay bricks in accordance with B. *Brick Paved Sidewalks and Driveways (Mortar Setting Bed)*.

**608-3.04 Grouted Stone Block Paved Sidewalks and Driveways.** Install grouted stone blocks in the pattern shown in the contract documents to provide a uniform, even surface. Ensure joints between blocks are a maximum of 1-1/4 inch. Do not lay or grout blocks in freezing weather. After installation, sweep a dry mixture of masonry mortar over the stone blocks until the joints are completely filled and then lightly wet the joints with water. Clean stone blocks of excess mortar, and finish joints prior to the mortar setting up. Keep grouted stone block paving moist for 4 days after filling the joints with mortar. After the four day curing period, remove remaining mortar film using a light acid wash (10% ± solution of hydrochloric or muriatic acid) followed by flushing clean with water, or as approved by the Engineer. Avoid the use of acid in areas where runoff could damage trees or other vegetation.

**A. Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed).** Lay blocks in a bed of cushion sand, 3 inch thick over the subbase or subgrade.

When used over tree pits, install stone blocks in a 1 inch bed of cushion sand. After placement of blocks, sweep dry cushion sand over the stone blocks until the joints are completely filled. Do not use mortar to seal stone block joints in tree pits.

**B. Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed).** Lay stone blocks in a mortar setting bed, a minimum of 1 inch thick over the concrete or bituminous subbase.

**C. Grouted Stone Block Paved Sidewalks and Driveways (Sand-Cement Setting Bed).** Lay stone blocks on a 2 inch thick setting bed of sand-cement over the subbase. Place the sand-cement setting bed not more than 4 hours prior to installing the block paving.

**D. Grouted Stone Block Paved Sidewalks and Driveways (Optional Concrete Setting Bed).** Install grouted stone block paved sidewalks and driveways using one of the following methods, at the Contractor's option:

1. Lay stone blocks on a bed of portland cement concrete as specified in the contract documents while it is still fresh and firmly position blocks to provide a solid bedding under each block.
2. Lay stone blocks in accordance with B. *Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed)*.

**608-3.05 Precast Concrete Block Paved Sidewalks and Driveways.** Install precast concrete driveway and sidewalk pavers, in the pattern shown in the contract documents to provide a uniform, even surface. Lay blocks on a setting bed not to exceed 2 inches of uniformly compacted material placed over the specified subbase. Install the pavers in accordance with the manufacturer's recommended procedures. Ensure joints are hand tight unless otherwise specified. Do not lay pavers in freezing weather. After the pavers are in place, sweep sand joint filler over the pavers until the joints are completely filled.

**608-3.06 Surface-Applied Detectable Warning Units.** Install surface-applied detectable warning units on existing curb ramps in accordance with the contract documents and the manufacturer's recommendations for environmental conditions, surface preparation, installation procedures, curing procedures, and materials compatibility. If no color is specified in the contract documents, provide dark gray Federal Standard #36081 or darker. Ensure the detectable warning units provide the required contrast, light-on-dark or dark-on-light, with the adjacent sidewalk or ramp.

**608-3.07 Embedded Detectable Warning Units.** Install embedded detectable warning units in plastic concrete, directly on existing subbase prior to placing concrete, or inlaid on prepared concrete surfaces in accordance with the contract documents and as directed by the manufacturer. If no color is specified in the contract documents, provide dark gray Federal Standard #36081 or darker. Ensure the detectable warning units provide the required contrast, light-on-dark or dark-on-light, with the adjacent sidewalk or ramp.

Follow all applicable manufacturers' recommendations for environmental conditions, surface preparation, installation procedures, curing procedures, and materials compatibility.

#### **608-4 METHOD OF MEASUREMENT**

**608-4.01 Portland Cement Concrete Sidewalks and Driveways.** The quantity to be measured for payment will be in cubic yards to the nearest 0.1 cubic yard of concrete installed.

**608-4.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips.** The quantity to be measured for payment will be in tons to the nearest 0.01 tons of HMA installed. The HMA produced for these types of applications is considered certified material in accordance with Materials Procedure (MP) 401. A Quality Adjustment Factor (QAF) of 1.00 will be assigned to Material meeting the specification requirement as certified by the Quality Control Technician (QCT). A QAF of 0.85 will be assigned to material that fails to meet the specification as tested by the Quality Assurance Technician (QAT). Quality Units will be determined when there is a disincentive and will be calculated as per §402-4, Method of Measurement.

**608-4.03 Brick Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of brick paving installed.

**608-4.04 Grouted Stone Block Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of stone block paving installed.

**608-4.05 Precast Concrete Block Paved Sidewalks and Driveways.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of precast concrete paving installed.

**608-4.06 Surface-Applied Detectable Warning Units.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of surface-applied detectable warning units installed.

**608-4.07 Embedded Detectable Warning Units.** The quantity to be measured for payment will be in square yards to the nearest 0.1 square yard of embedded detectable warning units installed.

#### **608-5 BASIS OF PAYMENT**

**608-5.01 Portland Cement Concrete Sidewalks and Driveways.** The unit price bid for concrete sidewalks and driveways shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including preparing the subgrade, saw cutting and wire fabric reinforcement. Excavation and subbase course will be paid for separately.

**608-5.02 Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips.** The unit price bid for HMA sidewalks, driveways and paths shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including preparing the subgrade, milling, cleaning surfaces, tack coat, saw cut, truing and leveling courses. Excavation and subbase course will be paid for separately. Payment adjustments will be made when there is a disincentive based on the Quality Units multiplied by the fixed index price for HMA items listed in the contract documents for the quantity placed on the day the Quality Adjustment Factor represent.

**608-5.03 Brick Paved Sidewalks and Driveways.** The price bid for brick paved sidewalks and driveways shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

**608-5.04 Grouted Stone Block Paved Sidewalks and Driveways.** The unit bid for grouted stone block paved sidewalks and driveways shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

**608-5.05 Precast Concrete Block Paved Sidewalks and Driveways.** The unit price bid for precast concrete block paved sidewalks and driveways shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including setting bed material. Excavation and subbase course will be paid for separately.

**608-5.06 Surface-Applied Detectable Warning Units.** The unit price bid for surface-applied detectable warning units shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including surface preparation.

**608-5.07 Embedded Detectable Warning Units.** The unit price bid for embedded detectable warning units shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including bedding material. No adjustment will be made for concrete removed to accommodate embedded units.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
608.0101	Concrete Sidewalks and Driveways	Cubic Yard
608.0102	Accelerated Cure Sidewalks and Driveways	Cubic Yard
608.020102	Hot Mix Asphalt (HMA) Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips	Ton
608.000013	Plant Production Quality Adjustment to HMA Sidewalks, Driveways, Bicycle Paths, and Vegetation Control Strips	Quality Unit
608.03	Brick Paved Sidewalks and Driveways (Sand Setting Bed)	Square Yard
608.04	Brick Paved Sidewalks and Driveways (Mortar Setting Bed)	Square Yard
608.05	Brick Paved Sidewalks and Driveways (Bituminous Setting Bed)	Square Yard
608.06	Brick Paved Sidewalks and Driveways (Sand-Cement Setting Bed)	Square Yard
608.07	Brick Paved Sidewalks and Driveways (Optional Concrete Setting Bed)	Square Yard
608.08	Grouted Stone Block Paved Sidewalks and Driveways (Sand Setting Bed)	Square Yard
608.09	Grouted Stone Block Paved Sidewalks and Driveways (Mortar Setting Bed)	Square Yard

608.10	Grouted Stone Block Paved Sidewalks and Driveways (Sand-Cement Setting Bed)	Square Yard
608.11	Grouted Stone Block Paved Sidewalks and Driveways (Optional Concrete Setting Bed)	Square Yard
608.12	Precast Concrete Block Paved Sidewalks and Driveways (Granular Material Setting Bed)	Square Yard
608.20	Surface-Applied Detectable Warning Units	Square Yard
608.21	Embedded Detectable Warning Units	Square Yard

## **SECTION 609 - CURB AND CURB & GUTTER**

(Last Revised January, 2022)

**609-1 DESCRIPTION.** Construct and place curb, and curb & gutter, and/or reset curb as indicated in the Contract Documents or established by the Engineer.

**609-2 MATERIALS.** The materials shall meet the requirements of the following subsections of Section 700 - Materials and Manufacturing.

Portland Cement, Type II	701-01
Concrete Repair Material	701-04
Concrete Grouting Material	701-05
Anchoring Material - Chemically Curing	701-07
Concrete Repair Material - High Early Strength	701-12
Coarse Aggregate	703-02
Concrete Sand	703-07
Premolded Resilient Joint Filler	705-07
Masonry Mortar	705-21
Stone Curb Anchor Bars	709-07
Quilted Covers (for Curing)	711-02
Plastic Coated Fiber Blankets (for Curing)	711-03
Polyethylene Curing Covers (White Opaque)	711-04
Membrane Curing Compound	711-05
Stone Curb	714-01
Precast Concrete Curb	714-04

### **609-2.01 (Vacant)**

### **609-2.02 Concrete for Cast-in-Place Concrete Curb and Curb & Gutter.**

**A. Conventionally Formed Curb and Curb & Gutter.** Provide concrete meeting the requirements for Class D in accordance with Section 501 *Portland Cement Concrete-General*. Provide concrete that contains an ASTM Type A water-reducing admixture meeting the requirements of §711-08 *Admixtures* and provides a minimum of 10% reduction of the design water content from the target mix design for Class D.

**B. Machine-Formed Concrete Curb and Curb & Gutter.** Use Class J Concrete as specified in Section 501, Portland Cement Concrete - General.

**609-2.03 Stone Curb.** Stone curb shall conform to the requirements for Stone under §714-01.

**609-2.04 Curb Anchors.** Curb anchors for cast-in-place concrete curb, and curb & gutter shall be fabricated from material conforming to the requirements for Longitudinal Joint Ties §705-14 and to the details shown on the Standard Sheet for concrete curb or as indicated in the Contract Documents.

**609-2.05 Concrete for Backing and Bedding Precast Concrete Curb and Stone Curb.** The Contractor shall use any Class Concrete, or a concrete mix as specified in Section 501 proportioned as follows:

<b>TABLE 609-1 POUNDS OF AGGREGATE PER BAG OF CEMENT</b>				
Specific Gravity of Aggregate	2.60	2.70	2.80	2.90
Concrete Sand	326	337	350	364
Coarse Aggregate, CA 2 Gradation	536	556	558	597

### 609-3 CONSTRUCTION DETAILS

**609-3.01 General.** Curb or curb & gutter found to be dirty, damaged, or out of alignment shall be cleaned, repaired, or replaced as necessary by the Contractor to the satisfaction of the Engineer prior to final acceptance of the work. When the Contract Documents have no reference to placing curb across driveway entrances, no curb shall be placed across driveway entrances.

**609-3.02 Setting Precast Concrete Curb or Stone Curb.** All precast concrete curb and stone curb, excluding stone traversable sloped (TRS) curb, shall be set on a 3-inch thick continuous bed of dry concrete mix, or on a 3 inch thick dry concrete mix bed at the joints as shown on the Standard Sheets and wet concrete mix between the joints, or on a 3-inch minimum thickness continuous bed of compacted granular material, at the Contractor's option.

Precast concrete curb and stone curb, excluding stone traversable sloped curb and Lean Back curb, shall be backed up with concrete using one of the following methods depending on the type of pavement:

**A. Portland Cement Concrete (Rigid) Pavement.** The Contractor shall place concrete backing behind the curb at each joint. The backing shall extend a minimum of 12 inch on both sides of the joint. The minimum height of the concrete backing shall be 6 inches and shall be measured from the bottom of the curb.

**B. Hot Mix Asphalt (Flexible) Pavement.** The Contractor shall place a continuous concrete backing behind the curb. The minimum height of the concrete backing shall be 10 inches or to the top of the hot mix asphalt pavement, whichever is greater, measured from the bottom of the curb.

Lean Back (LB) curbs are not allowed for installation with Portland Cement Concrete (Rigid) Pavement and shall be backed up as shown on the standard sheets for HMA (Flexible) Pavement.

Precast curb and stone curb, excluding stone traversable sloped curb, with and without sawed ends, not on a structure, shall be butted together with no mortar between the joints.

When the curb is set next to a concrete (rigid) pavement, grout conforming to §701-04 Concrete Repair Material, §701-12 Concrete Repair Material - High Early Strength, or §705-21 Masonry Mortar shall be placed in the joint formed between the curb and the pavement. The grout shall extend from the bottom to the top of the pavement slab.

Before proceeding with any further work adjacent to the curb, the curb shall be backfilled with material approved by the Engineer and the backfill material shall be thoroughly tamped as per contract documents.

**609-3.03 Stone Curb - Bridge Type.** The requirements of §609-3.02 shall apply with the following modifications:

- A. Unless special construction details are called for in the Contract Documents, Type A bridge curbs, when on a structures approach, shall be set true to line and grade on a concrete bedding.
- B. Type F1 bridge curbs shall be set in full mortar beds on structures. Excess mortar which extrudes around the curb shall be struck off flush with the front face of the curb and the top surface of the roadway.
- C. Anchor bars for stone bridge curb shall be installed where and as indicated in the Contract Documents.

All curb on structures shall be fitted together allowing ¼-inch full mortared joints finished flush with exposed curb surfaces. Curb surfaces shall be cleaned of excess mortar to the satisfaction of the Engineer.

Mortar used for bedding and filling of joints shall conform to §705-21 Masonry Mortar, §701-04 Concrete Repair Material or §701-12 Concrete Repair Material - High Early Strength.

**609-3.04 Cast-In-Place Concrete Curb and Curb & Gutter.** Cast-in-place concrete curb and curb & gutter shall either be conventionally formed or machine formed to the size and shape shown on the Standard Sheets or as indicated in the Contract Documents. If no width is indicated in the Contract Documents, the width shall be the minimum shown on the Standard Sheet.

Curb anchors, as required on the Standard Sheets or the Contract Documents, shall not be coated with materials which impair bonding. Curb anchors shall be installed a minimum of 12 inches from the ends of a pavement slab. Curb anchors for new concrete pavement, when placed simultaneously with pavement concrete, shall be placed by equipment which can demonstrate to the satisfaction of the Engineer placement of the anchors in accordance with these specifications. Curb anchors, when not placed simultaneously with pavement concrete, shall be placed rigidly secured by chairs or other supports to prevent displacement of the anchors when pavement concrete is placed. Curb anchors for existing concrete pavement shall be inserted into holes drilled in the side of the existing concrete pavement. The holes shall be thoroughly cleaned and filled with Concrete Grouting Material §701-05 or Anchoring Materials - Chemically Curing §701-07 immediately before placing the curb anchor. The curb anchor shall be securely supported in position until the grout has hardened.

Curing of the curb and curb & gutter shall comply with the requirements of §502-3.11 Curing, except that a clear membrane curing compound with fugitive dye conforming to the requirements of Membrane Curing Compound §711-05 may be used in lieu of the white pigmented membrane curing compound.

#### **A. Conventionally Formed Curb and Curb & Gutter**

**1. Forms.** Forms shall be free from warp and of such construction that there will be no interference to inspection for grade and alignment. All forms shall extend to the full curb depth and be secured so no displacement will occur during the placement of concrete.

**2. Casting Segments.** Curb and curb & gutter shall be cast in segments having a uniform length of approximately 10 feet. The joints between segments shall not exceed 1/4 inch in width. When curb and curb & gutter is constructed next to concrete pavement, the curb and curb & gutter joints shall line up with the pavement joints or additional joints shall be provided in the curb and curb & gutter which line up with the pavement joints.

**3. Expansion Joints.** Expansion joints shall be 3/4 inches wide and contain Premolded Resilient Joint Filler §705-07. The filler shall be cut to conform to the cross section of the curb and curb & gutter.

Expansion joints shall be located at all immovable objects (bridge structures, etc.), adjacent to expansion joints in the pavement, and where shown in the Contract Documents or directed by the

Engineer. Expansion joints will not be required at regular intervals unless otherwise shown in the Contract Documents.

**4. Concrete Placing and Vibrating.** Concrete shall be placed in the forms in accordance with the applicable requirements of §555-3.04 and shall be compacted with an immersion type mechanical vibrator. The vibrator shall be of a size and weight capable of thoroughly vibrating the concrete without damaging or misaligning the forms. The forms shall be left in place until the concrete has hardened sufficiently to permit removal without damage to the curb and curb & gutter. The front form may be removed before the other forms to facilitate finishing the curb and removal of the joint dividers. After removal of the forms, the exposed faces of the curb and curb & gutter shall be immediately rubbed to a uniform surface. No plastering will be permitted.

**B. Machine Formed Concrete Curb and Curb & Gutter.** The equipment proposed for use by the Contractor shall demonstrate, to the satisfaction of the Engineer, the capability of placing the concrete in accordance with these specifications.

When machine forming, the Contractor may provide additional width of curb above the minimum on the Standard Sheets or above the width indicated in the Contract Documents without any other change in shape or dimension. If additional width is provided by the Contractor, there shall be no additional cost to the State for the additional width. If the Contract Documents or the Engineer do not require curb be placed across driveway entrances or there is no reference in the Contract Documents to placing curb across driveway entrances, the Contractor may continue placing curb across driveway entrances but the curb placed, excluding transitions, must be cut out and the concrete disposed in a manner approved by the Engineer.

Any curb and curb & gutter placed outside the tolerance of 1/2 inch of the established line or 1/4 inch of the established grade shall be removed and replaced by the Contractor.

**1. Crack Control Joints.** Crack control joints shall be formed or saw cut to a width of 1/8 inch minimum, 1/4 inch maximum and to a depth of 1 1/2 inch. The cut or formed joints shall extend slightly below the surface of the adjacent pavement and shall be spaced at 10 feet intervals. When the curb, and curb & gutter is constructed next to concrete pavement, the curb and curb & gutter joints shall line up with the pavement joints or additional joints shall be provided in the curb and curb & gutter which line up with the pavement joints. The saw cut or formed joints shall be left unfilled.

**2. Expansion Joints.** Expansion joints shall be 11/16 inches wide and contain Premolded Resilient Joint Filler §705-07. The filler shall be cut to conform to the cross section of the curb and curb & gutter.

The expansion joints shall be located at all immovable objects (bridge structures, etc.), adjacent to expansion joints in the pavement, where shown in the Contract Documents, or directed by the Engineer. Expansion joints shall not be required at regular intervals unless otherwise shown in the Contract Documents.

**609-3.05 Setting Stone Traversable Sloped Curb.** Stone traversable sloped curb (TRS) shall be set on a continuous trapezoidal shaped wedge bed of dry concrete mix, with 12 inches of wet concrete mix at the front base and 6 inches at the back top as shown on the Standard Sheets. Stone traversable curb shall be set such that the front bottom arris line is at the top of pavement and is on a 1 on 3 slope.

**A. Portland Cement Concrete (Rigid) Pavement.**

**1. Existing Pavement.** The Contractor shall place the stone traversable sloped curb on a wedge bed of dry concrete mix, as above, on the edge of the existing pavement. The wet concrete mix

backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. There shall be no wet concrete mix base.

**2. New Pavement.** The Contractor shall place the stone traversable sloped curb after paving. The stone traversable sloped curb shall be placed on a wedge bed of dry concrete mix, as above, on the edge of the new pavement. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. There shall be no wet concrete mix base.

## **B. Hot Mix Asphalt (Flexible) Pavement.**

**1. Existing Pavement.** The Contractor shall sawcut 12 inches of the pavement and place the stone traversable sloped curb. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. The wet concrete mix base shall be placed on the subbase course and finished flush with the top of the binder allowing the top course to be placed over the concrete base. The wet concrete mix base shall be cured before placing of top course.

**2. New Pavement.** The Contractor shall place the stone traversable sloped curb after paving, decreasing the paving width, excluding the top course, by one foot where the stone traversable sloped curb is to be placed. The wet concrete mix backing shall be continuous. The minimum height of the concrete backing shall be 2 inches below top of curb, top front arris line, to allow topsoil and seeding or as shown on the plans. The wet concrete mix base shall be placed on the subbase course and finished flush with the top of the binder course allowing the top course to be placed over the concrete base. The wet concrete mix base shall be cured before placing of top course.

Stone traversable sloped curb, with and without sawed ends, not on structure, shall be placed with joints of 1/4 inch to 3/4 inch but with a consistent joint width throughout. Grout conforming to §701-04 Concrete Repair Material or §705-21 Type M Masonry Mortar shall be placed in the joint formed between the curb lengths. The grout shall extend from the bottom to the top of the curb section completely filling the joint and struck flush with curb surface. Curb surfaces shall be cleaned of excess mortar to the satisfaction of the Engineer.

Before proceeding with any further work adjacent to the curb, the curb shall be backfilled with material approved by the Engineer and the backfill material shall be thoroughly tamped.

**609-3.06 Optional Curb.** Under Optional Curb, the Contractor shall have the option of placing precast concrete curb, or cast-in-place concrete curb, or stone curb. Precast concrete curb or stone curb shall be placed in accordance with the requirements of §609-3.02. Cast-in-place curb shall be placed in accordance with the requirements of §609-3.04. No intermixing of curb will be allowed without the Engineer's written permission. Optional Lean Back Stone Curb shall be at the contractor's option.

**609-3.07 Resetting Curb.** Care shall be taken in removing the curb to be reset so that there will be no unnecessary breakage. All curb damaged in removing, hauling, storing, or resetting shall be replaced by the Contractor.

The curb shall be reset, in accordance with the requirements of §609-3.02 or §609-3.03 for resetting bridge type curbs, to the lines and grades specified in the Contract Documents.

**609-4 METHOD OF MEASUREMENT.** All curb and curb & gutter placed, and curb reset under these specifications will be measured by the number of linear feet, rounded to the nearest foot. The



measurement will be taken along the top front arris line of full height, transition and terminal sections. The measurement will be taken along the top front arris line of curb reveals across driveway entrances only when placed and not removed.

**609-5 BASIS OF PAYMENT**

**609-5.01 Concrete Curb, Curb & Gutter, Stone Curb, Optional Curb.** The unit price bid per foot shall include the cost of all labor, materials, equipment, curb anchors, saw-cutting and excavation to place, backfill, concrete, grouting and caulking, curb & gutter in accordance with these specifications. When select backfill is specified, the select backfill will be paid under its respective item. No additional payment will be made to the Contractor when more than the minimum width of curb is placed. No additional payment will be made to the Contractor when curb (including bedding) is removed and replaced across driveway entrances to facilitate concrete machine forming operations.

**609-5.02 Stone Curb - Bridge Type.** The unit price bid per foot shall include the cost of furnishing all labor, equipment, and materials including concrete bedding, mortar for stone curbs, chemically curing anchoring materials, and stone curb anchors required to bed and place stone bridge curb, in accordance with these specifications.

**609-5.03 Resetting Curb.** The unit price bid per foot shall include the cost of furnishing all labor, equipment, and materials to remove, haul, store and reset curb, in accordance with these specifications. In addition, the unit price shall also include any re-dressing of tops and joints of bridge type curb, as directed by the Engineer, and replacement of curb damaged by the Contractor's operations.

*Payment will be made under:*

<u>Item No.</u>	<u>Item</u>	<u>Pay Unit</u>
609.0212	Stone Curb – Near Vertical Face (NVF)	Foot
609.0213	Stone Curb - Optional Lean Back (LB) for HMA pavement	Foot
609.0214	Stone Curb – Mountable (MT)	Foot
609.0215	Stone Curb – Light Duty (LD)	Foot
609.0216	Stone Curb – Traversable Sloped (TRS)	Foot
609.0217	Stone Curb – Traversable (TR)	Foot
609.0218	Stone Curb – Roundabout (RD)	Foot
609.0301	Stone Curb – Bridge (Type A)	Foot
609.0302	Stone Curb – Bridge (Type F1)	Foot
609.0350	Stone Bridge Curb (As Detailed)	Foot
609.04	Cast-in-Place Concrete Curb (As Detailed)	Foot
609.04XX	Cast-in-Place Concrete Curb (Various Types as indicated)	Foot
609.05	Cast-in-Place Concrete Curb & Gutter (As Detailed)	Foot
609.05XX	Cast-in-Place Concrete Curb & Gutter (Various Types as indicated)	Foot
609.08XX	Precast Concrete Curb (Various Types as indicated)	Foot
609.0901	Optional Curb (Precast Concrete Type PVF6 or Cast-In-Place Concrete Type VF6 or Stone Type NVF)	Foot
609.0902	Optional Curb (Precast Concrete Type PM4 or Cast-In-Place Concrete Type M4 or Stone Type MT)	Foot
609.0903	Optional Curb (Precast Concrete Type PT4 or Cast-In-Place Concrete Type T4)	Foot
609.0904	Optional Curb (Precast Type Pm6 Or Cast-In-Place Type M6 )	Foot
609.15	Resetting Existing Curb	Foot

## **SECTION 610 - GROUND VEGETATION - PREPARATION, ESTABLISHMENT AND MANAGEMENT**

### **610-1 DESCRIPTION.**

**610-1.01 Topsoil.** This work shall consist of furnishing, screening, storing, stockpiling and placing topsoil in accordance with the contract documents and as directed by the Engineer.

**610-1.02 Preparation of Subsoil for Turf Establishment.** This work shall consist of ground preparation when topsoil is not included in the work prior to establishment of turf in accordance with the contract documents and as directed by the Engineer.

**610-1.03 Turf Establishment.** The work shall consist of ground preparation and establishing turf in accordance with the contract documents and as directed by the Engineer.

**610-1.04 Wildflower Seeding.** The work shall consist of ground preparation, furnishing and placing wildflower seeding materials and caring for wildflower areas in accordance with the contract documents and as directed by the Engineer.

**610-1.05 Sod.** The work shall consist of ground preparation, furnishing, installing and caring for sod in accordance with the contract documents and as directed by the Engineer.

**610-1.06 Soil Amendments.** The work consists of furnishing and placing soil amendments in accordance with the contract documents and as directed by the Engineer.

**610-1.07 Compost.** The work consists of furnishing, placing and incorporating compost in accordance with the contract documents and as directed by the Engineer.

**610-1.08 Mulch for Planting.** The work consists of furnishing and placing mulch, in accordance with the contract documents and as directed by the Engineer.

**610-1.09 Permeable Weed Control Landscape Fabric.** The work consists of furnishing and placing permeable landscape fabric for weed control, in accordance with the contract documents and as directed by the Engineer.

**610-1.10 Watering Vegetation.** This work shall include watering turf, sod, wildflower seeding, trees, shrubs, ground covers, vines, other plants, and filling portable drip irrigation systems in accordance with the contract documents and as directed by the Engineer.

**610-1.11 Weed Removal.** This work shall consist of removal and disposal of all native and non-native weeds including roots from newly established turf and sod areas, wildflower seeded areas, tree and shrub pits and plant beds in accordance with the contract documents and as directed by the Engineer.

**610-1.12 Mowing.** This work shall consist of mowing newly established seeded or sodded areas including the removal and disposal of any debris and litter which has accumulated prior to or between mowings, in accordance with the contract documents and as directed by the Engineer.

**610-1.13 Mowing Limits Markers.** This work consists of furnishing and installing mowing limit markers in accordance with the contract documents and as directed by the Engineer.

### **610-2 MATERIALS**

**610-2.01 Topsoil.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*. Excavated material from earthwork operations defined in Section 203 *Excavation and Embankment* that is unsuitable for embankments but conforms to §713-01 *Topsoil* is acceptable.

Topsoil	713-01
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**610-2.02 Preparation of Subsoil for Turf Establishment.** None specified.

**610-2.03 Turf Establishment.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
Seeds	713-04
Mulch For Turf Establishment and Erosion Control	713-11
Mulch anchorage	713-12
Straw	713-19

**610-2.04 Wildflower Seeding.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
Seeds	713-04
Mulch For Turf Establishment and Erosion Control	713-11
Mulch anchorage	713-12
Straw	713-19

**610-2.05 Sod.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
Topsoil	713-01
Sod	713-14

**610-2.06 Soil Amendment.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
Limestone	713-02
Fertilizer	713-03
Mycorrhizal Fungi	713-09
Moisture Retention Additive	713-10
Sulfur	713-17

**610-2.07 Compost.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Compost	713-15
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**610-2.08 Mulch for Planting.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Mulch for Planting	713-05
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**610-2.09 Permeable Weed Control Landscape Fabric.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Weed Control Barriers	713-18
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**610-2.10 Watering Vegetation.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water

712-01

**610-2.11 Weed Removal.** None specified.

**610-2.12 Mowing.** None specified.

**610-2.13 Mowing Limits Markers.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Materials for the Protection of Plants

713-08

### **610-3 CONSTRUCTION DETAILS**

#### **610-3.01 Topsoil.**

**A. General.** The subsoil within the areas to be covered by topsoil shall be graded so that the completed work after the topsoil is placed shall conform to the specified lines and grades. The Contractor shall scarify or till the surface of the subsoil to a depth of 6 inches before the topsoil is placed to permit bonding the topsoil with the subsoil. Tillage by disking, harrowing, raking or other approved methods shall be accomplished in such a manner that depressions and ridges formed by tillage shall be parallel to the contours.

Topsoil in an unworkable condition due to excessive moisture, frost, or other conditions shall not be placed until its consistency is workable for spreading. Topsoil shall be placed on the designated area and spread to the depth specified in the contract documents or a minimum of 4 inches for turf areas and 3 inches for sod areas.

The finished surface shall be maintained for subsequent contract work such as seeding, sodding, mulching or planting.

The sites of all stockpiles shall be graded and maintained for subsequent contract work. Surplus topsoil will become the property of the Contractor.

Roots and top growth of non-native weeds or invasive species that emerge from topsoil stockpiles or after placement of the topsoil shall be eradicated and disposed of in accordance with §610-3.11 *Weed Removal* immediately upon emergence. Weed removal, treatment and disposal of invasive species will be paid for separately.

**B. Topsoil – Reuse On-Site Materials.** Topsoil stripping shall be completed prior to starting the general excavation in an area. The Contractor shall take reasonable care that the topsoil is not contaminated during the stripping and other handling operations.

Topsoil identified for reuse that has a known, established population of invasive species shall be treated to eliminate the presence of invasive species per §610-3.11 *Weed Removal*. The invasive species material shall be disposed appropriately and then the resulting topsoil may be used within the limits. Treatment and disposal of invasive species will be paid for separately.

**C. Topsoil – Roadside, Lawn, Special Planting Mix and Acidic.** The Contractor shall place topsoil only from approved stockpiles.

**D. Topsoil – On-Site Wetland and Wetland Off-Site or Manufactured.** The Contractor shall not use topsoil wetlands materials which exhibit the presence of invasive species. Care shall be taken not to impact wetland areas remaining.

On-site wetland topsoil stripping shall be completed prior to starting the general excavation in an area. After stripping, on-site wetland topsoil shall be placed within 24 hours or stored within the contract limits at a location approved by the Engineer.

**610-3.02 Preparation of Subsoil for Turf Establishment.** Prior to establishment of turf in areas that are not to receive topsoil or other permanent erosion control measures, the Contractor shall remove all loose stones and other objects over 2 inches in size to a 4 inch depth. The Contractor shall mix compost with subsoil in accordance with §610-3.07 B. *Turf Establishment With No Topsoil/ On Subsoil* within the areas to be seeded and grade the surface so that the completed work shall conform to the specified finished lines and grades. Compost will be paid for separately.

**610-3.03 Turf Establishment.** The Contractor shall coordinate establishment of turf with other site and construction activities.

The Contractor shall clean all equipment involved in turf establishment to remove plants, seeds and propagules prior to commencement of work. Any work to clean equipment shall be at no additional cost to the State.

The Contractor shall apply the seed mix at one and one half to two times the manufacturer's recommended rate. Any method of sowing that does not injure the seeds and achieves even coverage in the process of spreading will be acceptable.

The Contractor shall perform the initial watering and shall spread straw uniformly in a continuous blanket to hide the soil from view or mulch Types I – V as specified in the contract documents. Rolled Erosion Control products shall be installed according to manufacturer's recommendations and paid for separately. Mulch anchorage shall be applied.

The Contractor shall water, mow, and weed the turf establishment areas for the duration of the contract or until turf areas are accepted. Watering, mowing, and weeding to care for the turf will be paid for separately. Any work required to correct initial seeding (installation) shall be done at no additional cost to the State.

**A. Turf Establishment – Roadside.** Areas will be accepted when:

- free from thin or bare ground greater than one foot in diameter;
- at least 80 percent of the ground surface is covered with established specified permanent turf grass species;
- they have had one mowing cycle in accordance with §610-3.12 unless conditions prevent mowing, in which case turf grass shall be an average minimum height of 5 inches; and
- they exhibit healthy green color.

**B. Turf Establishment- Lawns.** Areas will be accepted when:

- free from thin or bare spots greater than six inches in diameter;
- at least 90 percent of the ground surface is covered with established specified permanent turf grass species;
- they have had one mowing cycle in accordance with §610-3.12 unless conditions prevent mowing, in which case turf grass shall be an average minimum height of 3 inches; and
- they exhibit healthy green color.

**610-3.04 Wildflower Seeding.** The Contractor shall clean all equipment involved in wildflower seeding to remove plants, seeds and propagules prior to commencement of work at no additional cost to the State.

The Contractor shall install wildflower seeding materials in accordance with the contract documents. Any method of sowing that does not injure the seeds and provides soil contact in the process of spreading

will be acceptable. The Contractor shall apply the seed mix at twice the seed supplier’s recommended rate.

The Contractor shall perform the initial watering and spread straw or mulch Types I – V as specified in the contract documents, uniformly at a rate consistent with seed supplier recommendations. Mulch anchorage is required unless otherwise specified in the contract documents. Wildflower seeding areas will be accepted after the seeding operation is complete. Any work required to correct initial seeding (installation) shall be done at no additional cost to the State.

The Contractor shall water the wildflower seeding areas for the duration of the contract. Watering to care for the wildflower seeding areas will be paid for separately.

**610-3.05 Sod.** The Contractor shall generally place sod during the seasons identified in Table 610-1 *Sodding Seasons*. The Contractor may request extension of seasons, provided the other conditions are met.

<b>TABLE 610-1 SODDING SEASONS</b>		
<b>Geographic locations</b>	<b>Spring</b>	<b>Fall</b>
R1-Essex, Warren (north of towns of Bolton & Warrensburg), R2-Hamilton, Herkimer (towns of Ohio and Webb) R7-Lewis, St. Lawrence, Franklin, Clinton, Jefferson (east of Rte 81)	4/15-6/30	8/15-10/15
R1– Greene, Rensselaer, Schenectady, Saratoga, Washington, Albany, Warren (towns of Bolton & Warrensburg & south) R2- Montgomery, Fulton, Oneida, Madison, Herkimer (south of town of Ohio) R3,6,9 – All counties R7- Jefferson (west of Route 81)	4/1-6/15	8/15-10/31
R4, 5 & 8- All counties	4/1 – 5/31	8/15 – 10/31
R10, 11- All counties	3/1-4/30	8/21-11/15

The subgrade of areas to be sodded shall be excavated and firmed to a sufficient depth below the finished grade of the sod to accommodate the tamped or rolled thickness of topsoil and sod. No frozen sod shall be placed nor shall sod be placed on frozen ground surface.

The Contractor shall exercise care to retain the soil existing on the roots of the sod during transporting, handling and transplanting operations.

Sod shall be placed on a minimum of 3 inches of moist topsoil. The topsoil will be paid for separately.

The finished sod soil surface shall be flush with surface of the adjacent soil and adjacent structures. It shall meet the finished grades as shown in the contract documents.

Sod will be accepted when:

- It has been in place a minimum of 60 days after installation,
- It is 95 percent covered with permanent grass species,
- It has had one mowing cycle in accordance with §610-3.12 *Mowing*,
- It exhibits healthy green color,
- It is free from thin, bare or brown spots greater than 6 inches in diameter, and
- It is firmly rooted in the soil.

Sod not meeting the standards for acceptance, shall be re-sodded until a satisfactory turf has been established, at no additional expense to the State.

The Contractor shall water, mow and weed the sodded areas as necessary until contract final acceptance. These items will be paid for separately.

**610-3.06 Soil Amendments.** The Contractor shall place, apply or incorporate fertilizer, limestone, mycorrhizal fungi, sulfur and/or moisture retention additive where shown in the contract documents.

When mycorrhizal fungi are specified, application rates for turf shall ensure an even distribution of 100,000 propagules minimum per acre for drill seeding and 1,000,000 propagules minimum per acre for hydroseeding. Application rates for planting and Tree Root Zone Treatment, as well as any other aspects of distributing and/or incorporating mycorrhizal fungi, shall be in accordance with the manufacturer's recommendations.

All other amendments shall be mixed with topsoil prior to placing, spread evenly over the surface of turf, wildflower or sod areas, applied within shrub saucers or applied over the plant beds as appropriate, at the rates recommended by the manufacturer or as specified in the contract documents. The method of application shall ensure an even distribution. When hydraulic application is used, the minimum rate of water application shall be in accordance with manufacturer's recommendation.

Trees shall be fertilized using Method No. 1, No. 2 or No. 3 in accordance with the contract documents.

**A. Method No. 1.** Holes shall be made in the earth about 18 inches deep and 18 inches apart, and located in the outer two-thirds (as measured on the radius) of the circular area lying under the limits of the tree branches. The holes shall be made with a crowbar, soil auger, pneumatic equipment or other approved tools and care shall be taken to avoid injury to the roots. Fertilizer shall be applied at the rate specified; placing equal amounts of fertilizer in the lower 12 inches of each hole.

**B. Method No. 2.** Fertilizer shall be applied to soil's surface hydraulically at the rate specified with sufficient water to saturate the soil for the area and depth of the tree roots without creating air pockets.

**C. Method No. 3.** Fertilizer rate and method of application shall be as specified in the contract documents.

### **610-3.07 Compost.**

**A. Existing Soil:** The Contractor shall spread 2 inches of Compost Type A or E within the limits shown in the contract documents and tilled into existing soil to a total depth of six inches.

**B. Turf Establishment With No Topsoil/ On Subsoil.** The Contractor shall spread 2 inches of Compost Type A, D or E within the limits shown in the contract documents and tilled into subsoil to a minimum depth of four inches.

**C. Turf Establishment With Topsoil.** The Contractor shall mix Compost Type A, D or E with topsoil as specified in the contract documents.

**D. Plant Pits or Beds:** Compost Type A, D or E shall be applied at a ratio of 1 part compost to 5 parts existing soil.

**610-3.08 Mulch for Planting.** The Contractor shall apply mulch consisting of wood chips, pine nuggets or shredded bark to the surface of the beds and tree pit areas in accordance with the contract documents. The Contractor shall apply mulch to a uniform depth of 3 inches over the shrub bed and tree pit areas and 2 inches over groundcover beds. The mulch shall be distributed so as to create a smooth, level cover over the exposed soil. Mulch shall not cover plants or be in contact with tree root flare, tree trunks, and plant stems.

**610-3.09 Permeable Weed Control Landscape Fabric.** Areas where landscape fabric is to be installed shall be smooth, firm, stable and free of rocks, clods, foliage, roots, trash, debris or other material that will prevent the matting from lying in direct contact with the soil surface.

The landscape fabric shall be placed where shown in the contract documents and as required by the manufacturer.

**610-3.10 Watering Vegetation.** The Contractor shall provide water without damage to plants, mulch, stakes, plant saucers, sod or other areas to be watered. Damage resulting from watering operations shall be repaired at no additional cost to the State.

Watering shall be applied in accordance with §610-3.03 *Turf Establishment*, §610-3.04 *Wildflower Seeding*, §610-3.05 *Sod* or §611-3.01 *General*. Watering for existing vegetation shall be as specified in the contract documents.

Watering shall be applied at the following rates:

**A. Turf, Wildflowers, Sod, Planting Beds.** In the absence of 1 inch of rainfall within 5 consecutive calendar days the Contractor shall water all turf, wildflowers, sod and planting beds once a week to a depth of 1 inch.

**B. Trees and Planting Pits.** Between April 1st and November 15<sup>th</sup>, in the absence of 1 inch of rainfall within 5 consecutive calendar days, the Contractor shall apply water to trees and planting pits once per week, except during July and August, when water shall be applied twice per week, with a minimum of 2 days between applications. Soil saucers or portable drip irrigation systems shall be filled once per watering.

**610-3.11 Weed Removal.** The Contractor shall perform weed removal in accordance with the contract documents. The Contractor shall remove and dispose of weeds including roots prior to flowering and seed formation by manual, chemical or mechanical means. Any method of weed removal that leaves live roots in the soil will not be permitted. An appropriately licensed applicator is required for chemical weed control methods. The Contractor shall ensure the preservation of desirable vegetation. Treatment and removal of invasive species will be paid for separately.

**610-3.12 Mowing.** The schedule may be modified to accommodate prevailing or forecast weather conditions. The Contractor shall be responsible, prior to each mowing, for the removal and disposal of any debris and litter which has accumulated since the last mowing. Care shall be taken to avoid damage to existing plant materials.

**A. Roadside.** The Contractor shall mow all turf establishment areas to a height of 5 inches whenever growth reaches 8 inches for the duration of the contract. Clippings shall be left in place.

**B. Lawns.** The Contractor shall mow all turf establishment areas to a height of 3 inches after initial growth reaches 5 inches, and then mowed to a height of 3 inches whenever a 5 inch height is reached thereafter for the duration of the contract. Clippings shall be mulched in place.

**C. Sod.** The Contractor shall mow all sodded areas to a height of 3 inches after initial growth reaches 5 inches, and then mowed to a height of 3 inches whenever a 5 inch height is reached thereafter for the duration of the contract. Clippings shall be mulched in place.

**610-3.13 Mowing Limits Markers.** The Contractor shall install mowing limit markers plumb to a depth in accordance with the manufacturer's instruction.



## **610-4 METHOD OF MEASUREMENT**

**610-4.01 Topsoil.** The quantity to be measured for payment will be in cubic yards of each type of topsoil measured to the nearest whole cubic yard of topsoil placed, from payment lines shown in the contract documents.

Cross sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown on the Plans and cannot be reasonably established by the Engineer.

**610-4.02 Preparation of Subsoil for Turf Establishment.** The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of subsoil area prepared for turf establishment.

**610-4.03 Turf Establishment.** The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of turf established.

**610-4.04 Wildflower Seeding.** The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of wildflower seeding.

**610-4.05 Sod.** The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard of sod placed.

**610-4.06 Soil Amendments.** The quantity to be measured for payment will be in pounds to the nearest whole pound or in gallons to the nearest whole gallon of soil amendments (fertilizer, limestone, mycorrhizal fungi, sulfur and/or moisture retention additive) applied.

**610-4.07 Compost.** The quantity to be measured for payment will be in cubic yards to the nearest whole cubic yard of compost placed or incorporated.

**610-4.08 Mulch for Planting.** The quantity to be measured for payment will be in cubic yards to the nearest whole cubic yard of mulch placed.

**610-4.09 Permeable Weed Control Landscape Fabric.** The quantity to be measured for payment will be in square yards on slope to the nearest whole square yard.

**610-4.10 Watering Vegetation.** The quantity to be measured for payment will be in 1000 gallons (MGal) to the nearest MGal of water applied, determined from approved measuring devices, or by measurement in tanks or containers of known capacity.

**610-4.11 Weed Removal.** The quantity to be measured for payment will be in square yards on slope weeded per occurrence to the nearest whole square yard.

**610-4.12 Mowing.** The quantity to be measured for payment will be the number of square yards on slope mowed per occurrence to the nearest whole square yard.

**610-4.13 Mowing Limits Markers.** The quantity to be measured for payment will be by the number of complete markers satisfactorily installed.

## **610-5 BASIS OF PAYMENT**

**610-5.01 Topsoil.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including the handling, storing, stockpiling, and placement.

**610-5.02 Preparation of Subsoil for Turf Establishment.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work

**610-5.03 Turf Establishment.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, mulch and mulch anchorage as necessary to satisfactorily complete the work.

**610-5.04 Wildflower Seeding.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, mulch and mulch anchorage necessary to satisfactorily complete the work.

**610-5.05 Sod.** The unit price bid shall include the cost of all labor, materials and equipment including initial water, necessary to complete the work. Topsoil bed placed under the sod shall be paid for separately.

**610-5.06 Soil Amendments.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including water for hydraulic application.

**610-5.07 Compost.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work

**610-5.08 Mulch for Planting.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

**610-5.09 Permeable Weed Control Landscape Fabric.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

**610-5.10 Watering Vegetation.** The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

**610-5.11 Weed Removal.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

**610-5.12 Mowing.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

**610-5.13 Mowing Limits Markers.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
610.0501	Fertilizer	Pound
610.0502	Fertilizer	Gallon
610.06	Limestone	Pound
610.0701	Mycorrhizal Fungi	Pound
610.0702	Mycorrhizal Fungi	Gallon
610.08	Moisture Retention Additive	Pound
610.0901	Sulfur	Pound
610.0902	Sulfur	Gallon
610.10	Compost	Cubic Yard

610.1101	Mulch for Planting Type A, B & D – Wood Chips and Shredded Bark	Cubic Yard
610.1102	Mulch for Planting Type C – USDA-APHIS Protocol Wood Chips	Cubic Yard
610.1103	Mulch for Planting Type E – Pine Nugget	Cubic Yard
610.1201	Permeable Weed Control Landscape Fabric	Square Yard
610.1202	Permeable Weed Control Landscape Fabric with Herbicide	Square Yard
610.13	Weed Removal	Square Yard
610.1401	Topsoil – Reuse On-Site Materials	Cubic Yard
610.1402	Topsoil - Roadside	Cubic Yard
610.1403	Topsoil - Lawns	Cubic Yard
610.1404	Topsoil - Special Planting Mix	Cubic Yard
610.1405	Topsoil – Acidic	Cubic Yard
610.1406	Topsoil – On-Site Wetland Materials	Cubic Yard
610.1407	Topsoil – Wetland Materials	Cubic Yard
610.15	Preparation of Subsoil for Turf Establishment	Square Yard
610.1601	Turf Establishment - Roadside	Square Yard
610.1602	Turf Establishment -Lawns	Square Yard
610.17	Wildflower Seeding	Square Yard
610.18	Sodding	Square Yard
610.19	Watering Vegetation	1,000 Gallons
610.21	Mowing	Square Yard
610.22	Mowing Limits Markers	Each

## **SECTION 611 - PLANTING, TRANSPLANTING AND POST PLANTING CARE**

### **611-1 DESCRIPTION.**

#### **611-1.01 General.** Vacant

**611-1.02 Planting.** This work consists of furnishing, and planting trees, shrubs, vines, groundcovers and other plants in accordance with the contract documents and as directed by the Engineer.

**611-1.03 Transplanting.** This work consists of transplanting existing plants from existing locations to new locations in accordance with the contract documents and as directed by the Engineer.

**610-1.04 Portable Drip Irrigation System.** This work shall consist of furnishing, delivering, placing and removing Portable Drip Irrigation System (PDIS) for watering around newly planted trees and other vegetation in accordance with the contract documents and as directed by the Engineer.

**611-1.05 Post-Planting Care.** This work consists of the care of newly planted and transplanted trees, shrubs, vines, groundcovers and other plants in accordance with the contract documents and as directed by the Engineer.

**611-1.06 Rodent Guards.** This work shall consist of furnishing, delivering and placing rodent guards around newly planted trees and other vegetation in accordance with the contract documents and as directed by the Engineer.

### **611-2 MATERIALS**

**611-2.01 General.** Materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
Topsoil	713-01
Mulch for Landscape Bedding	713-05
Materials for the Protection of Plants	713-08
Compost	713-15

**611-2.02 Planting.** Trees, shrubs, vines, groundcovers and other plants shall be as specified under ' 713-06 and as further specified in the contract documents.

**611-2.03 Transplanting.** Plants shall be existing plants in accordance with ' 713-06.

**611-2.04 Portable Drip Irrigation System.** The materials shall meet the requirements of the following subsections of *Section 700 Materials and Manufacturing*. Materials may be new or previously used that meet the following material requirements.

Materials for the Protection of Plants	713-08
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**611-2.05 Post Planting Care.** Materials shall meet the requirements of the following subsections of *Section 700 Materials and Manufacturing*.

Pesticides	713-13
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**611-2.06 Rodent Guards.** Materials shall meet the requirements of the following subsections of *Section 700 Materials and Manufacturing*.

Materials for the Protection of Plants	713-08
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### 611-3 CONSTRUCTION

**611-3.01 General.** Locations for plants shall be as specified in the contract documents. All plants for planting and transplanting shall be protected from damage and drying out, including during transportation, handling or while in temporary storage. No planting or transplanting shall be done when the soil is frozen, saturated (except in wetland conditions) or otherwise in an unsatisfactory condition for working. Planting seasons represent average times of suitable conditions between weather extremes. In general, planting or transplanting shall occur during these seasons. The Contractor may request an extension of the planting seasons.

TABLE 611-1 PLANTING SEASONS					
Planting Seasons	Spring		Fall		
Geographic locations (NYSDOT Regions and Counties)	Deciduous & Evergreen B&B	Deciduous & Evergreen Container Grown	Evergreen B&B	Deciduous B&B	Deciduous & Evergreen Container Grown
<b>(USDA 3b-4a)</b> R1- Essex, Warren (north of towns of Warrensburg & Bolton) R2-Hamilton, Herkimer (towns of Ohio & Webb) R7-Lewis, St. Lawrence, Franklin, Clinton, Jefferson (east of Route 81)	4/15-5/31	4/15-5/31	8/15-9/30	9/15-10/31	8/15 - 10/31
<b>(USDA 4a-5a)</b>	4/1-5/15	4/1 – 5/31	8/15-9/30	9/15-11/15	8/15-11/15

R1–Greene, Rensselaer, Schenectady, Saratoga, Washington, Albany, Warren (towns of Bolton & Warrensburg & south) R2- Montgomery, Fulton, Oneida, Madison, Herkimer (south of town of Ohio) R3,6,9 – All counties R7- Jefferson (west of Route 81)					
<b>(USDA 5a-6a)</b> R4, 5 & 8- All counties	3/15-5/15	3/15 – 5/31	8/15-10/15	9/15-11/30	8/15-11/30
<b>(USDA 6b-7a)</b> R10, 11- All counties	3/1-5/15	3/1 – 5/31	8/15-10/31	10/1-12/15	8/15-12/15
All Locations	Bare Root stock shall be planted while dormant				

Locations for plants and outlines of areas to be planted shall be staked or marked out on the ground by the Contractor and approved by the Engineer before any plant pits or plant beds are dug. Where non-movable underground obstructions are encountered, the plant pits shall be relocated as approved by the Engineer.

Existing vegetation shall be removed from all new planting beds.

Where an impervious layer of soil (hardpan, fragipan and soils with greater than 20% clay content) is encountered during the excavation of plant pits or beds, all such soil shall be removed up to a depth of one foot beyond required plant pit depth in order to provide adequate drainage for the plant. The pits or beds shall be backfilled with topsoil. Any additional excavation required to properly plant or transplant in impervious soils will be considered extra work.

Planting soil shall be unamended existing soil excavated from the plant pit unless otherwise specified. Watering shall accompany backfilling of plant. The Contractor shall perform the initial watering for backfilling plant so that no voids occur in the plant pit.

No tree shall be staked, guyed or anchored unless otherwise specified in the contract documents.

Mulch shall Type A or B unless otherwise specified in the contract documents and shall be placed at the time of planting or transplanting.

The Contractor shall water, weed and maintain mulch at no cost to the state until the newly planted or transplanted material is accepted.

Plants will be accepted when all specified plants meet the following conditions:

- Species has been verified and plant is in its designated location
- Planted or transplanted in accordance with ANSI A 300, Part 1, 2, 3 and 6 *Standard Practices*
- Planted or transplanted in accordance with 611 Standard sheets
- living, healthy, unimpaired and in an undamaged condition

Watering, if specified, shall begin upon acceptance of the planting or transplanting and unless otherwise specified continue for one year or the duration of the contract, which ever is later. Watering after acceptance shall be performed as required in Section 610-3.09 *Watering Vegetation* and paid for separately. Installation of rodent guards if specified are paid for separately.

Plants that die after acceptance at any time during the contract duration shall be removed and unless otherwise specified, the surface area shall be restored to the condition of the adjacent surface at no additional cost to the state.

**611-3.02 Planting.** The Contractor shall notify the Engineer at least four calendar days before intended delivery of plants or planting materials to the site. The Contractor shall furnish the Engineer legible copies of the certificates of inspection of plant materials and documentation for each shipment showing point of origin, sizes, scientific names, quantities, and kinds of materials supplied.

Planting shall be in accordance with ANSI A300 Part 1, 2 and 3 *Standard Practices*.

Pruning at the time of planting shall be limited to the removal of dead, conflicting and broken branches; and to other pruning consistent with good horticultural practice in accordance with ANSI A300 Part 1 *Standard Practices*.

**611-3.03 Transplanting.** Transplanting shall be in accordance with ANSI A300 Part 1, 2, 3 and 6 *Standard Practices* and accomplished by a digging method intended to preserve the root system intact to the extent practicable. Planting soil shall be unamended existing soil excavated from the plant pit unless otherwise specified. Transplanted stock shall be pruned prior to transplanting in accordance with ANSI A300 Part 1 *Standard Practices*.

The Contractor shall take appropriate measures to avoid damage to plant during the transplanting operation including:

1. Provide trunk and branch Protection.
2. Treat plant with an anti-desiccant prior to being dug up
3. Protect all roots from drying out.
4. Prune damaged plant roots greater than 1 inch in diameter

Plants shall be set in a vertical position.

Where the contract duration allows plants greater than 6 inch DBH shall be root pruned up to one year prior to transplanting.

**611-3.04 Portable Drip Irrigation System (PDIS).** After the requirements for planting under Section 611 *Planting, Transplanting and Post Planting Care* are completed; the Contractor shall supply and install the required number and size of PDIS as recommended by the manufacturer for the trees planted. Watering shall be performed as required in Section 610-3.09 *Watering Vegetation* and paid for separately. All PDIS that are damaged and or missing shall be replaced at no added cost to the State.

The Contractor shall remove PDIS in the fall prior to the first frost. The PDIS shall remain the property of the Contractor.

**611-3.05 Post-Planting Care.** If specified, the Contractor shall care for planting as needed for one year following the satisfactory completion of all of the planting and/or transplanting or for the duration of the contract, which ever is later. The contractor shall prepare and submit a post-planting care work schedule for approval.

Post-planting care shall consist of:

1. Mulching – with materials to match those used in initial planting, twice to maintain a depth of 3 inches.
2. Weeding - twice
3. Integrated vegetation and pest management- in the event of threat of serious damage from insects or diseases the plants shall be treated by preventative or remedial measures.
4. Pruning (ANSI A300 Part 1) - once to prune dead or damaged branches.
5. Maintenance/Replacement/of tree support system if present – once every six months
6. Removal of tree support system if present at the end of the post-planting care period.
7. Removal of rodent guards if present at the end of the post-planting care period

**611-3.06 Rodent Guards.** Vacant

**611-4 METHOD OF MEASUREMENT.**

**611-4.01 Planting.** The quantity to be measured for payment will be the number of plants placed.

**611-4.02 Transplanting.** The quantity to be measured for payment will be the number of plants placed.

**611-4.03 Portable Drip Irrigation System (PDIS).** The quantity of PDIS to be measured for payment will be the number of PDIS placed.

The quantity of Removal of Portable Drip Irrigation System to be measured for payment will be the number of PDIS removed.

**611-4.04 Post-Planting Care.** The quantity to be measured for payment will be the number of plants cared for or nearest whole square yard on slope of plants cared for.

**611-4.05 Rodent Guards.** The quantity to be measured for payment will be the number of rodent guards placed.

**611-5 BASIS OF PAYMENT.**

**611-5.01 Planting.** The unit price bid for each plant shall include the cost of all labor, materials, and equipment, including initial watering and mulch, compost, plants and plant protection materials and topsoil necessary to satisfactorily complete the work.

**611-5.02 Transplanting.** The unit price bid for each plant shall include the cost of all labor, materials, and equipment, including initial watering, mulch, compost, plant and plant protection materials and topsoil necessary to satisfactorily complete the work.

**611-5.03 Portable Drip Irrigation System.** The unit price bid shall include the cost of all labor, materials, and equipment, necessary to satisfactorily complete the work.

**611-5.04 Post-Planting Care.** The unit price bid for each plant shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments for work satisfactorily performed may be paid at the mid point of the post-planting care in amounts not to exceed forty percent (40%) of the unit price bid for the respective work.

**611-5.05 Rodent Guards.** The unit price bid shall include the cost of all labor, materials, and equipment, necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
611.011x	Planting - Major Deciduous Trees – size as specified	Each
611.012x	Planting - Major Deciduous Trees – 1 ¼ inch Caliper	Each
611.013x	Planting - Major Deciduous Trees – 1 ½ inch Caliper	Each
611.014x	Planting - Major Deciduous Trees – 1 ¾ inch Caliper	Each
611.015x	Planting - Major Deciduous Trees – 2 inch Caliper	Each
611.016x	Planting - Major Deciduous Trees – 2 ½ inch Caliper	Each
611.017x	Planting - Major Deciduous Trees – 3 inch Caliper	Each
611.018x	Planting - Major Deciduous Trees – 3 ½ inch Caliper	Each
611.019x	Planting - Major Deciduous Trees – 4 inch Caliper	Each
611.021x	Planting - Minor Deciduous Trees – size as specified	Each
611.022x	Planting - Minor Deciduous Trees – 3 foot height	Each

611.023x	Planting - Minor Deciduous Trees – 4 foot height	Each
611.024x	Planting - Minor Deciduous Trees – 5 foot height	Each
611.025x	Planting - Minor Deciduous Trees – ¾ inch Caliper	Each
611.026x	Planting - Minor Deciduous Trees – 1 inch Caliper	Each
611.027x	Planting - Minor Deciduous Trees – 1 ¼ inch Caliper	Each
611.028x	Planting - Minor Deciduous Trees – 1 ½ inch Caliper	Each
611.029x	Planting - Minor Deciduous Trees – 1 ¾ inch Caliper	Each
611.020x	Planting - Minor Deciduous Trees – 2 inch Caliper	Each
611.031x	Planting - Coniferous Trees – size as specified	Each
611.032x	Planting - Coniferous Trees – 2 ½ foot height	Each
611.033x	Planting - Coniferous Trees – 3 foot height	Each
611.034x	Planting - Coniferous Trees – 4 foot height	Each
611.035x	Planting - Coniferous Trees – 5 foot height	Each
611.036x	Planting - Coniferous Trees – 6 foot height	Each
611.037x	Planting - Coniferous Trees – 7 foot height	Each
611.038x	Planting - Coniferous Trees – 8 foot height	Each
611.039x	Planting - Coniferous Trees – 9 foot height	Each
611.041x	Planting - Deciduous Shrubs –As Specified	Each
611.042x	Planting - Deciduous Shrubs – 15 inch Height/Spread	Each
611.043x	Planting - Deciduous Shrubs – 18 inch Height/Spread	Each
611.044x	Planting - Deciduous Shrubs – 2 foot Height/Spread	Each
611.045x	Planting - Deciduous Shrubs – 3 foot Height/Spread	Each
611.046x	Planting - Deciduous Shrubs – 4 foot Height/Spread	Each
611.047x	Planting - Deciduous Shrubs – 5 foot Height/Spread	Each
611.048x	Planting - Deciduous Shrubs – 6foot Height/Spread	Each
611.051x	Planting - Evergreen Shrubs – As Specified	Each
611.052x	Planting - Evergreen Shrubs – 15 inch Height/Spread	Each
611.053x	Planting - Evergreen Shrubs – 18 inch Height/Spread	Each
611.054x	Planting - Evergreen Shrubs – 2 foot Height/Spread	Each
611.055x	Planting - Evergreen Shrubs – 2 ½ foot Height/Spread	Each
611.056x	Planting - Evergreen Shrubs – 3 foot Height/Spread	Each
611.057x	Planting - Evergreen Shrubs – 3 ½ foot Height/Spread	Each
611.058x	Planting - Evergreen Shrubs – 4 foot Height/Spread	Each
611.059x	Planting - Evergreen Shrubs – 5 foot Height/Spread	Each

x= Root Specification

1= Ball & Burlap, Field Potted or Field Boxed,

2 = Container or Box Grown,

3 = Bare Root,

4 = In Ground Fabric Bag Grown

611.061y	Planting – Vines, Groundcovers – As Specified	Each
611.062y	Planting – Vines, Groundcovers – Number SP3 Container	Each
611.063y	Planting – Vines, Groundcovers – Number SP4 Container	Each
611.064y	Planting – Vines, Groundcovers – Number SP5 Container	Each
611.065y	Planting – Vines, Groundcovers – Number 1 Container	Each
611.066y	Planting – Vines, Groundcovers – Number 2 Container	Each
611.071y	Planting - Herbaceous Plants – As Specified	Each
611.072y	Planting - Herbaceous Plants – Number SP4 Container	Each
611.073y	Planting - Herbaceous Plants – Number SP5 Container	Each
611.074y	Planting - Herbaceous Plants – Number 1 Container	Each
611.075y	Planting - Herbaceous Plants – Number 2 Container	Each



y = Type Specification  
 1 = Container Grown,      2 = Bare Root  
 3 = Field Potted,

611.10	Transplanting 0 to 48 inch in height	Each
611.11	Transplanting over 48 inch to 72 inches in height	Each
611.12	Transplanting, over ¾ inch to 3 inches Diameter at Breast Height	Each
611.13	Transplanting, over 3 inches to 6 inches Diameter at Breast Height	Each
611.14	Transplanting over 6 inches to 12 inches Diameter at Breast Height	Each
611.15	Transplanting Vines, Groundcovers,	Each
611.16	Transplanting Herbaceous Plants	Each
611.17	Portable Drip Irrigation System	Each
611.18	Removal of Portable Drip Irrigation System	Each
611.19	Post-Planting Care	Each
611.20	Post-Planting Care	Square yard
611.21	Rodent Guard	Each

Refer to the Contract Proposal for full item number and full description

**SECTION 612 (VACANT)**

**SECTION 613 - WILDLIFE AND ECOLOGY**

**613-1 DESCRIPTION.**

**613-1.01 Terrestrial Habitat.** This work shall consist of the protection, preservation, restoration and management of terrestrial habitat.

**613-1.02 Aquatic Habitat.** This work shall consist of the protection, preservation, restoration and management of aquatic habitat.

**613-1.04 Wetlands.** This work shall consist of the protection, preservation, restoration and management of wetlands.

**613-1.06 Streams and Riparian Zones.** This work shall consist of the protection, preservation, restoration and management of rivers, streams and riparian zones.

**613-2 MATERIALS.** As specified in the special specifications.

**613-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**613-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**613-5 BASIS OF PAYMENT.** As specified in the special specifications.

**SECTION 614 - PRUNING, IMPROVING AND REMOVING EXISTING VEGETATION**

**614-1 DESCRIPTION.**

**614-1.01 Pruning Existing Trees.** This work shall consist of pruning existing trees as shown in the contract documents and as directed by the Engineer.

**614-1.02 Improvement of Vegetated Areas.** This work shall consist of cutting, disposing of all wood and debris, stump removal, or mechanical or chemical treatment of specified trees and woody vegetation within the area shown in the contract documents and as directed by the Engineer.

**614-1.03 Tree Removal.** The work shall consist of felling trees over 4 inch in diameter at breast height, disposing of all wood and debris, and may require topping, stump removal and other work as shown in the contract documents and as directed by the Engineer.

**614-1.04 Existing Stump Removal.** The work shall consist of removing existing stumps, disposing of all wood and debris, as shown in the contract documents and as directed by the Engineer.

**614-1.05 Tree Root Zone Treatment (Vertical Mulching/Aeration).** This work shall consist of treating the root zone of trees through aeration and/or mulching of the roots as shown in the contract documents and as directed by the Engineer.

**614-1.06 Tree Root Pruning.** This work shall consist of cleanly pruning, existing tree roots severed during construction operations, typically related to linear excavation, as shown in the contract documents and as directed by the Engineer.

## **614-2 MATERIALS**

**614-2.01 Pruning Existing Trees.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
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**614-2.02 Improvement of Vegetated Areas.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Topsoil	713-01
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Pesticides	713-13
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**614-2.03 Tree Removal.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Topsoil	713-01
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**614-2.04 Existing Stump Removal.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Topsoil	713-01
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**614-2.05 Tree Root Zone Treatment (Vertical Mulching/Aeration).** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Mortar Sand	703-03
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Mycorrhizal Fungi	713-09
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Compost	713-15
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**614-2.06 Tree Root Pruning.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

Water	712-01
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## 614-3 CONSTRUCTION DETAILS

### 614-3.01 Pruning Existing Trees

**A. Equipment.** Workers shall employ accepted tree climbing methods, and shall not climb trees with climbing spurs. All tools used and methods employed in accordance ANSI A300 Part 1 *Standard Practices*, except that no anvil type pruners will be permitted. The cutting surfaces of all tools, ladders, ropes, soles of workers shoes and other objects coming into contact with the tree shall be disinfected with a 2% bleach solution and dried completely prior to the start of any work on a tree to prevent the spread of plant diseases.

**B. Pruning.** Pruning shall be in accordance ANSI A300 Part 1 *Standard Practices*. When specified the quantity of trees as shown in the contract documents shall be pruned so the resulting crown retains the growth habit of the tree species. Any and all branches interfering with or hindering the healthy growth of the tree shall be removed. All diseased branches and all dead branches 1 inch or more in diameter shall be removed. Any branch which may be partly dead, yet has a healthy lateral branch at least one-third the diameter of the parent branch shall be removed beyond the healthy branch. All stubs or improper cuts resulting from former pruning shall be removed. All cuts shall be cleanly made with sharp tools as close to the parent trunk or limb as possible without disturbing the branch bark ridge or callus collar. All existing nails, spikes, wire, plastic or other materials found driven into or fastened to the trunk or branches shall be removed or if approved they shall be cut flush in a manner to permit complete healing over.

**614-3.02 Improvement of Vegetated Areas.** All trees and shrubs specified for removal will be designated by the Engineer either by separate marking, marking in sample areas, or otherwise. Unless otherwise specified, all stumps shall be cut to a height of about 6 inches above the ground. Unless otherwise specified, an approved herbicide shall be applied to all live stumps in accordance with the manufacturer's recommendations. An approved dye shall be added to the herbicide mixture to identify treated stumps and stubble. Where stump removal is specified, all stump holes shall be backfilled with topsoil, unless otherwise specified in the contract documents, and backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

Care shall be taken in the felling of trees and the operation of equipment to prevent injury to trees and shrubs which are to be preserved. All injuries to the limbs, bark and roots of such plants shall be repaired in accordance with ANSI A300 Part 1 *Standard Practices Pruning* and ANSI Z133.1 *Arboricultural Operations Safety*.

Improvement of vegetated areas shall be completed in any area before any planting, seeding or other landscape work is begun in that area unless otherwise approved.

All wood, stumps, brush and other debris resulting from the work shall be disposed of as specified in Section 201 *Clearing and Grubbing*.

**614-3.03 Tree Removal.** No tree shown in the contract documents or listed for removal shall be cut until it is approved by the Engineer. The contractor shall be responsible to coordinate all work involving utilities with the respective utility company. All trees shall be topped and limbed before felling unless otherwise approved. All injuries to the limbs, bark and roots of plants to remain shall be repaired in accordance with ANSI A300 *Standard Practices Pruning* and ANSI Z133.1 *Arboricultural Operations Safety*.

The Contractor shall field measure all trees at 4 ½ feet above the ground, commonly referred to as Diameter Breast Height (DBH) before they are cut.

Stumps of trees removed under this item for removal shall be grubbed, cut, ground to the depth of six inches below grade or as specified in the contract documents. All stump holes shall be backfilled with

topsoil, unless otherwise specified in the contract documents and backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

**614-3.04 Existing Stump Removal.** Existing stumps listed for removal in the contract documents shall be ground to the depth of 6 inches below grade unless otherwise specified in the contract documents. Stumps shall include all visible wood and roots. Backfill to finished grade with topsoil, unless otherwise specified in the contract documents. The backfill shall be compacted. Unless otherwise specified in the contract documents, grass shall be established on stump holes and will be paid for separately.

**614-3.05 Tree Root Zone Treatment (Vertical Mulching/Aeration).** Locations of work shall include areas within the dripline or wider root zone of existing trees to be preserved as shown on the contract documents.

Appropriate drilling tools shall be used for drilling of holes for root zone restoration. Drilling equipment shall be hand held or light weight devices (no heavy machinery) so as to avoid further impact to tree roots through compaction.

Holes shall be drilled and existing soil removed within a zone beginning 3 feet from the trunk of the specified tree and extending to its dripline on an approximately 2 foot x 2 foot grid. Dimensions of holes or drill size shall be approximately 2 inches in diameter and a minimum of 12 inches deep. Efforts should be made to minimize drilling through large tree roots (especially near the trunk). When woody roots are encountered, the drill hole shall be moved to avoid root damage.

The hole shall be completely filled to original grade as follows:

Method 1: with mortar sand

Method 2: with mortar sand amended with Mycorrhizal Fungi.

Method 3: with compost.

Method 4: with compost amended with Mycorrhizal Fungi.

When mycorrhizal fungi are specified, they shall be a dry granular powder specifically designed for vertical mulching applications. Apply in accordance with the manufacturer's recommendations at a rate of 3 ounces per hole or when pre-mixed in bulk 5 pounds per cubic yard of sand or compost.

**614-3.06 Tree Root Pruning.** Existing tree roots greater than 1 inch in diameter, measured at the edge of excavation, shall be pruned within 24 hours of the time they have been damaged by construction activity. The severed root shall be pruned at the edge of excavation, or 1 inch beyond the entire damaged portion of the tree root if damaged root extends beyond the edge of excavation into undisturbed soil. Pruning shall be in accordance with ANSI A300 Part 1 *Standard Practices Pruning* and ANSI Z133.1 *Arboricultural Operations Safety*. All cuts shall be cleanly made with sharp tools. The cutting surfaces of all tools, ladders, ropes, soles of workers shoes and other objects coming into contact with the tree roots shall be washed with a disinfectant at the start of any work on a tree to prevent the spread of plant diseases.

The excavated area around the existing tree roots shall be backfilled as soon as construction activities permit with the specified or approved materials. If the excavated area around the existing tree roots is not backfilled within 24 hours, all roots shall be kept moist, to prevent dessication.

## **614-4 METHOD OF MEASUREMENT**

**614-4.01 Pruning Existing Trees.** The quantity to be measured for payment will be the number of trees pruned.

**614-4.02 Improvement of Vegetated Areas.** The quantity to be measured for payment will be in square yards measured to the nearest whole square yard of area improved.

**614-4.03 Tree Removal.** The quantity to be measured for payment will be the number of trees, including their stumps if specified.

**614-4.04 Pre-Existing Stump Removal.** The quantity to be measured for payment will be the number of pre-existing stumps removed.

**614-4.05 Tree Root Zone Treatment (Vertical Mulching/Aeration).** The quantity to be measured for payment will be in square yards treated within the zone, measured to the nearest square yard.

**614-4.06 Tree Root Pruning.** The quantity to be measured for payment will be in feet to the nearest whole foot, along excavation line.

#### **614-5 BASIS OF PAYMENT**

**614-5.01 Pruning Existing Trees.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

**614-5.02 Improvement of Vegetated Areas.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

**614-5.03 Tree Removal.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

When trees are specified in the contract documents for removal, payment for each tree removal will include removal of the stump.

**614-5.04 Existing Stump Removal.** The unit price bid shall include the cost of labor, materials, and equipment necessary to satisfactorily complete the work.

**614-5.05 Tree Root Zone Treatment.** The unit price bid shall include the cost of labor, materials, equipment and incidentals necessary to complete the work. Mycorrhizal Fungi and mulch will be paid for separately.

**614-5.06 Tree Root Pruning.** The unit price bid shall include the cost of labor, materials, equipment and incidentals necessary to complete the work.

#### ***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
614.0411	Care of Trees up to 12” Diam. at Breast Height – Pruning	Each
614.0421	Care of Trees Over 12” to 24” Diam. at Breast Height - Pruning	Each
614.0431	Care of Trees Over 24” to 36” Diam. at Breast Height - Pruning	Each
614.0441	Care of Trees Over 36” to 48” Diam. at Breast Height – Pruning	Each
614.0451	Care of Trees Over 48” to 60” Diam. at Breast Height – Pruning	Each
614.0461	Care of Trees Over 60” Diam. at Breast Height – Pruning	Each
614.05	Improvement of Vegetated Areas	Square Yard
614.0601nn	Tree Removal Over 4” to 6” Diam. Breast Height	Each
614.0602nn	Tree Removal Over 6” to 12” at Breast Height	Each
614.0603nn	Tree Removal Over 12” to 18” at Breast Height	Each
614.0604nn	Tree Removal Over 18” to 24” at Breast Height	Each
614.0605nn	Tree Removal Over 24” to 36” at Breast Height	Each
614.0606nn	Tree Removal Over 36” to 48” at Breast Height	Each

614.0607nn	Tree Removal Over 48” to 60” at Breast Height	Each
614.0608nn	Tree Removal Over 60” to 72” at Breast Height	Each
	<i>nn = Stump Treatment</i>	
	<i>01 = Stumps Cut to Above Grade, 02 = Stumps Cut Flush,</i>	
	<i>03 = Stumps Cut to Below Grade, 04 = Stumps Grubbed</i>	
614.0701	Pre-Existing Stump Removal up to 24” diameter at 6 inches above grade	Each
614.0702	Pre-Existing Stump Removal over 24” to 48” diameter at 6 inches above grade	Each
614.0703	Pre-Existing Stump Removal over 48” diameter at 6 inches above grade	Each
614.08	Tree Root Zone Treatment (Vertical Mulching/Aeration)	Square Yard
614.09	Tree Root Pruning	Feet

## SECTION 615 - LANDSCAPE APPURTENANCES

**615-1 DESCRIPTION.** The work in this section shall include all work required for furnishing, placing, and/or special construction of landscape appurtenances.

**615-2 MATERIALS.** As specified in the special specifications.

**615-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**615-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**615-5 BASIS OF PAYMENT.** As specified in the special specifications.

## SECTION 616 - SOIL BIOENGINEERING

**616-1 DESCRIPTION.** This section shall include work required for soil bioengineering

**616-2 MATERIALS.** As specified in the special specifications.

**616-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**616-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**616-5 BASIS OF PAYMENT.** As specified in the special specifications.

## SECTION 617 - INVASIVE SPECIES MANAGEMENT

**617-1 DESCRIPTION.** This work shall consist of the control, eradication and management of invasive species.

**617-2 MATERIALS.** As specified in the special specifications.

**617-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**617-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**617-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 618 (VACANT)**

## **SECTION 619 - WORK ZONE TRAFFIC CONTROL**

(Last Revised May, 2022)

### **619-1 DESCRIPTION**

**619-1.01 General.** Work zone traffic control shall consist of all work necessary to provide for the safe and efficient movement of traffic through or around work zones, and to protect workers and the public from damage to person and property which may result, directly or indirectly, from any construction operations. Work zone traffic control shall be completed under the direction of a trained, competent person, as shown in the contract documents, the MUTCD and as directed by the Engineer. The duration of this work shall be from the date any work is started on the contract site, including mobilization of equipment, signs, offices, and shops until the date of contract final acceptance. Temporary materials and components that are furnished by the Contractor shall remain the property of the Contractor.

See Figure 619-1 *Component Parts of a Typical Highway Work Zone* for definitions of terms.

**619-1.02 Basic Work Zone Traffic Control.** Work shall consist of controlling traffic over a reasonably smooth traveled way which shall be marked by signs, delineators, channelizing devices, pavement markings, and other devices as shown in the contract documents or as directed by the Engineer. Work after sunset and before sunrise shall include additional requirements for nighttime operations including, but not limited to, a written plan for nighttime operations, additional worker and equipment protection, additional channelizing devices and contract site patrol.

The Contractor shall conduct its operations to ensure the safety and convenience of travelers and abutting property owners as well as the safety of all workers on the contract. Travelers include, but may not be limited to motorists, motorcyclists, bicyclists and pedestrians.

Work shall be scheduled to keep the time and distance that existing pavement is removed or substantially disturbed to a minimum and consistent with the physical requirements of the contract. Unless otherwise indicated in the contract documents, the distance over which traffic is maintained on an unpaved surface shall not exceed 1/2 mile at any one time. During seasonal shutdown periods, no part of the highway shall be closed to traffic unless provided for in the contract documents, or the Contractor has submitted and the Engineer has approved a detailed schedule of operations reflecting a proposal to close the highway to traffic.

Basic work zone traffic control shall include the following:

**A. Surface Condition, Debris, Drainage and Dust Control.** Work shall consist of maintaining the surface condition of the traveled way, including detours, consistent with the preconstruction posted speed limit; including maintaining positive drainage, dust control and keeping the roadway free from debris and materials spilled from or tracked by vehicles or equipment. Debris and dust shall be controlled on all operations.

**B. Seasonal Operations and Snow and Ice Control.** Work shall consist of maintaining the traveled way to facilitate safe, efficient travel and permit snow and ice control by others during winter months and during any period that work is suspended.

**C. Maintain Public Access.** Work shall consist of maintaining public access to intersecting roads, residences, business establishments, adjacent property, bus stops and transportation facilities for vehicles, pedestrians, and bicyclists.

**D. Maintain Existing Roadside Signs, Delineators and Markers.** Work shall consist of maintaining, in their existing condition, existing highway signs, delineators, and markers within the contract limits.

**E. Maintain Existing Guide Rail, Median Barrier and Bridge Rail.** Work shall consist of maintaining existing traffic barriers and other safety devices, in their existing condition, within the contract limits.

**F. Construction Vehicles and Equipment.** Work shall consist of equipping construction vehicles and equipment with warning lights and reflective markings; and maintenance of vehicles and equipment in safe operating condition.

**G. Barrier/Shadow Vehicles.**

**1. Barrier Vehicles.** Work shall consist of furnishing barrier vehicles to guide traffic and protect workers in stationary lane and shoulder closures and other stationary temporary traffic control zones, as shown in the contract documents or as directed by the Engineer.

**2. Shadow Vehicles.** Work shall consist of furnishing shadow vehicles to guide traffic and to protect workers in mobile or short duration work zones not protected by stationary lane or shoulder closures, as shown in the contract documents or as directed by the Engineer.

**H. Construction Signs.** Work shall consist of furnishing, installing, moving, maintaining, deactivating, and removing construction signs, including warning lights, as shown in the contract documents or as directed by the Engineer.

**I. Arrow Panels.** Work shall consist of furnishing, installing, maintaining, and removing arrow panels as shown in the contract documents or as directed by the Engineer. Arrow panels are used to warn and guide traffic when travel lanes are temporarily closed by construction activities.

**J. Channelizing Devices.** Work shall consist of furnishing, placing, maintaining and removing channelizing devices, with warning lights where required, including drums, vertical panels, construction barricades, cones, and temporary tubular markers. Type III construction barricades and interim tubular markers may be specified under separate pay items.

**K. Pavement Edge Drop-Off Protection.** Work shall consist of furnishing and maintaining protection for edge drop-offs adjacent to the pavement or shoulder.

**L. Flagging and Traffic Control.** Work shall consist of furnishing the necessary traffic control equipment and flaggers for adequate traffic control. Portable traffic signal systems authorized by the Engineer may be utilized only on a highway designated as a Restricted Highway.

**M. Maintain Existing Mailboxes.** Work shall consist of maintaining postal route mailboxes serviced from vehicles, in a useable condition and location consistent with U.S. Postal Service requirements.

**N. Contract Site Patrol.** Work shall consist of furnishing personnel to patrol the contract area as necessary to ensure conditions on the site are adequate for public safety and convenience at all times.



**619-1.03 Basic Work Zone Traffic Control (Daily Operations).** Work shall consist of controlling and protecting traffic during a single work shift as shown in the contract documents, or as directed by the Engineer. The Contractor will not be required to repair or maintain the surface of the traveled way and other roadway features not part of the work, except to repair damage resulting from the Contractor's operations.

**619-1.04 Temporary Business Signs.** Work shall consist of furnishing, installing, moving, covering, maintaining, and removing temporary business signs as shown in the contract documents or as directed by the Engineer.

**619-1.05 Covering or Removal of Pavement Markings.** Work shall consist of removing or covering existing permanent pavement markings, interim pavement markings, and temporary pavement markings including, but not limited to: edge lines, lane lines, center lines, crosswalks, stop bars, arrows, symbols, and diagonal markings in gores and medians as shown in the contract documents or as directed by the Engineer.

**619-1.06 Temporary Pavement Markings.** Work shall consist of furnishing and applying temporary pavement markings as shown in the contract documents or as directed by the Engineer. The work for removable pavement tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall include removal. Temporary pavement markings are intended for use on any new pavement or milled surface until the subsequent course is placed or interim pavement markings or final pavement markings are installed.

**619-1.07 Interim Pavement Markings.** Work shall consist of furnishing, applying, and maintaining, interim pavement markings as shown in the contract documents or as directed by the Engineer. Interim pavement markings are intended for use in diversions, temporary pavement realignments and crossovers, lane shifts and closures, and other traffic patterns associated with construction activities. Interim pavement markings are intended for use for a given phase or season, for a maximum of 1 year.

**619-1.08 Temporary Rumble Strips.** Work shall consist of installing, maintaining, and removing temporary rumble strips at the locations shown in the contract documents or as directed by the Engineer.

**619-1.09 Interim Tubular Markers.** Work shall consist of furnishing, installing, moving, and maintaining interim tubular markers attached to the pavement as shown in the contract documents or as directed by the Engineer. Interim tubular markers are typically used for 2-way, 2-lane freeway work zones and long-term closures where available width is limited.

**619-1.10 Portable Variable Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS).**

*A. Portable Variable Message Signs (PVMS).* Work shall consist of furnishing, installing, operating, maintaining, relocating, and removing PVMS as shown in the contract documents or as directed by the Engineer. PVMS with a pay unit of each shall be provided for the duration of the contract at the general locations specified in the contract documents and in accordance with the Special Note *Requirements for Portable Variable Message Signs (PVMS)*. PVMS with a pay unit of weeks shall be provided at general locations and durations in accordance with the Special Note *Requirements for Portable Variable Message Signs (PVMS)* and the contract documents.

PVMS are intended to supplement other traffic control devices by displaying symbolic or word messages, but are not to be used alone to replace conventional traffic control devices.

**B. Truck Mounted Variable Message Signs (TMVMS).** Work shall consist of furnishing, installing, operating, maintaining and relocating TMVMS as shown in the contract documents or as directed by the Engineer. TMVMS with a pay unit of each shall be provided for the duration of the contract at the general locations specified in the contract documents. TMVMS with a pay unit of *weeks* shall be provided at general locations and durations in accordance with the Special Note *Requirements for Truck Mounted Variable Message Signs* and the contract documents. TMVMS are intended to supplement other traffic control devices by displaying symbolic or word messages. They may only be used alone to replace conventional traffic control devices in mobile and short duration work zones or situations of limited duration.

**619-1.11 Type III Construction Barricades.** Work shall consist of furnishing, installing, moving, maintaining, and removing Type III construction barricades, with warning lights where specified, as shown in the contract documents or as directed by the Engineer.

**619-1.12 Temporary Positive Barrier.** Work shall consist of furnishing, installing, moving, maintaining, and removing approved temporary positive barrier (concrete or steel), including barrier warning lights and transitions to and from guide rail where specified, as shown in the contract documents or as directed by the Engineer.

**619-1.13 Temporary Glare Screen.** Work shall consist of furnishing, installing, moving, maintaining, and removing glare screen mounted on a concrete barrier as shown in the contract documents or as directed by the Engineer.

**619-1.14 Temporary Impact Attenuator.** Work shall consist of furnishing, installing, maintaining, repairing, moving and removing temporary impact attenuators as shown in the contract documents or as directed by the Engineer.

**619-1.15 Temporary Sand Barrel Arrays.** Work shall consist of furnishing, installing, maintaining, relocating and removing temporary sand barrel arrays as shown in the contract documents or as directed by the Engineer.

**619-1.16 Vehicle Arresting Barrier.** Work shall consist of providing vehicle arresting barriers (net-type) and their anchorages as shown on the Standard Sheets to prevent errant vehicles from entering a closed work area as shown in the contract documents or as directed by the Engineer.

**619-1.17 Maintain or Modify Traffic Signal Equipment.** Work shall consist of modifying or maintaining in proper operation, existing, relocated, modified, or newly installed traffic signals as shown in the contract documents or as directed by the Engineer.

**619-1.18 Temporary Traffic Signals.** Work shall consist of furnishing, installing, moving, maintaining, and removing temporary traffic signals and necessary components as shown in the contract documents or as directed by the Engineer. Temporary signals shall be installed only on a highway designated as a Restricted Highway.

**619-1.19 Nighttime Operations.** Work shall consist of developing a Nighttime Operations and Lighting Plan, and furnishing, installing, operating, maintaining, moving and removing lighting equipment for nighttime construction operations as shown in the contract documents or as directed by the Engineer.

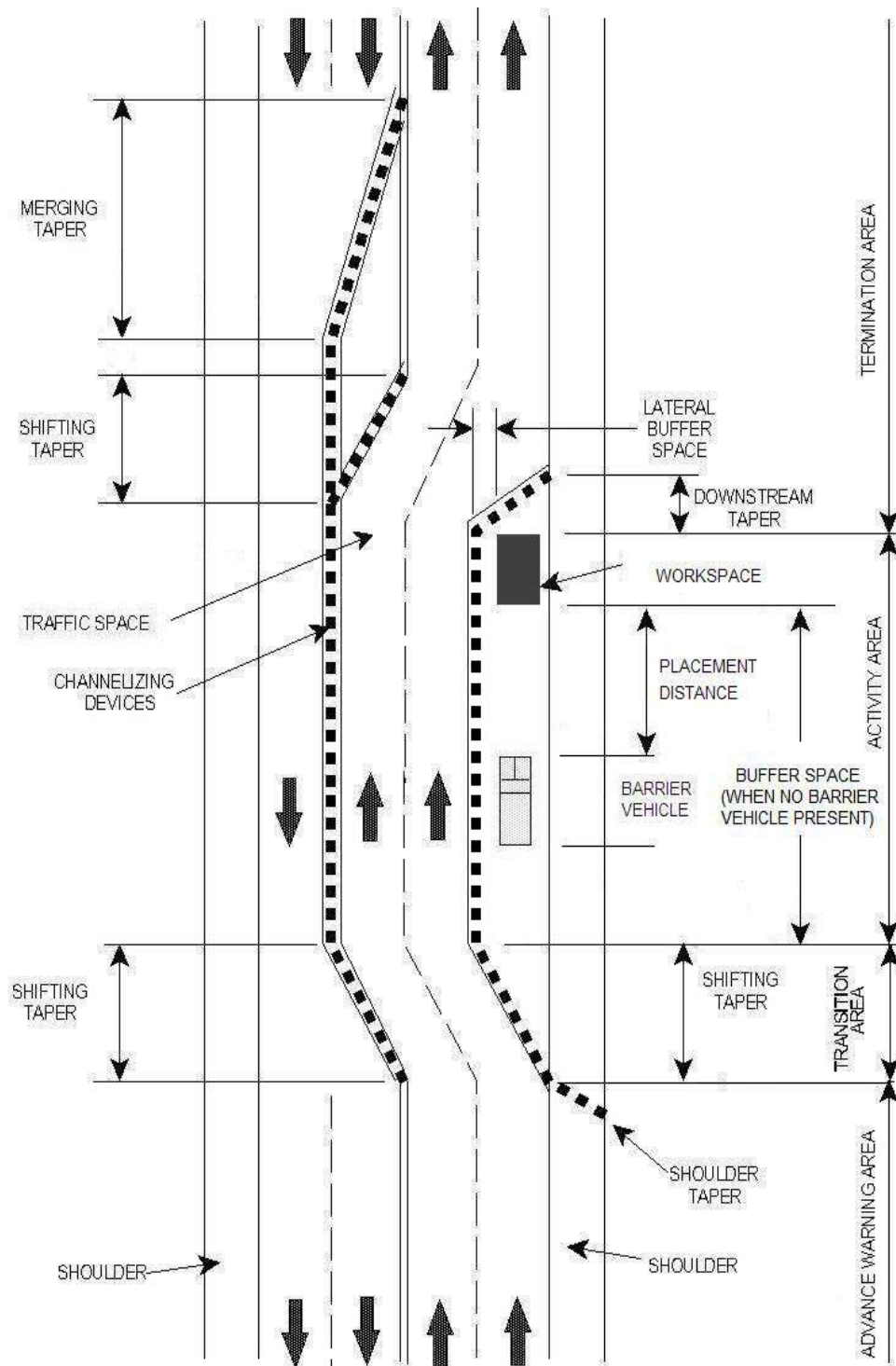
**619-1.20 Traffic Control Supervisor.** Work shall consist of providing a full-time traffic control supervisor having adequate training, experience, and authority to implement and maintain all traffic control operations, as shown in the contract documents or as directed by the Engineer.

**619-1.21 Temporary Structures and Approaches.** Work shall consist of designing, constructing, maintaining, inspecting, relocating, and removing temporary structures, their approaches and any required appurtenances at the location(s) shown in the contract documents.

**619-1.22 Pavement Patching.** Work shall consist of providing and installing pavement patching materials to maintain pavements open to traffic in acceptable condition as shown in the contract documents or as directed by the Engineer.

**619-1.23 Mailboxes.** Work shall consist of relocating or replacing postal route mailboxes and/or mailbox supports consistent with U.S. Postal Service requirements, as shown in the contract documents or as directed by the Engineer.

**FIGURE 619-1 COMPONENT PARTS OF A TYPICAL HIGHWAY WORK ZONE**



## 619-2 MATERIALS.

**619-2.01 General.** All materials used shall comply with the requirements of the following subsections of Section 700 *Materials and Manufacturing*, or as established by this section, the applicable Standard Sheets, and the contract documents.

Concrete Grouting and Anchoring Material	701-05
Precast Concrete Barrier	704-05
Epoxy Polysulfide Grout	721-03
Traffic Signal Heads	724-04
Removable Raised Pavement Markers	727-02
Epoxy Paint	727-03
Permanent Pavement Tape	727-04
Glass Beads for Pavement Markings	727-05
Removable Pavement Tape	727-06
Removable Wet-Night Reflective Tape	727-07
Permanent Wet-Night Reflective Tape	727-08
Traffic Paint	727-09
Drums	729-01
Cones	729-02
Temporary Tubular Markers	729-03
Vertical Panels	729-04
Stop/Slow Paddles	729-05
Type II Construction Barricades	729-07
Type III Construction Barricades	729-08
Temporary Sign Supports	729-09
Temporary Impact Attenuators - Redirective	729-10
Temporary Impact Attenuators - Gating	729-11
Truck-Mounted and Trailer Mounted Impact Attenuators	729-12
Temporary Sand Barrels	729-13
Vehicle Arresting Systems	729-14
Arrow Panels	729-15
Portable Variable-Message Signs	729-16
Temporary Glare Screens	729-17
Warning Lights	729-18
Automated Flagging Assistance Devices	729-19
Portable Traffic Signals	729-20
Temporary Overlay Markers	729-21
Truck Mounted Variable Message Signs	729-22
Aluminum Sign Panels	730-01
Temporary Plywood Sign Panels	730-02
Temporary Rigid Lightweight Sign Panels	730-03
Retro-Reflective Sign Sheeting	730-05
Temporary Wooden Sign Posts	730-19
Stiffeners, Overhead Brackets and Miscellaneous Hardware	730-22
Fiberglass Reinforced Plastic Sign Panels	730-23
Type A Sign Supports	730-24
Type B Sign Posts	730-25

Note: Signs and panels supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type III/IV and/or IX retro-reflective sign sheeting based on the sign type.

## 619-2.02 Basic Work Zone Traffic Control.

**A. Surface Condition, Debris, Drainage and Dust Control.** Materials used to repair pavement surfaces shall be compatible with the pavement. In general, plant-mixed hot mix asphalt is suitable for all pavement surfaces to be repaired. Material other than plant-mixed hot mix asphalt may be used if approved by the Engineer.

Environmentally compatible, approved dust palliatives may be used in conformance with any conditions placed on their use.

**B. Seasonal Operations and Snow and Ice Control.** (None Specified)

**C. Maintain Public Access.** (None Specified)

**D. Maintain Existing Roadside Signs, Delineators and Markers.** All materials used to maintain existing roadside appurtenances shall be consistent with the features to be maintained.

**E. Maintain Existing Guide Rail, Median Barrier and Bridge Rail.** All materials used to maintain existing roadside appurtenances shall be consistent with the features to be maintained.

**F. Construction Vehicles and Equipment.** All vehicles with a GVWR greater than 10,000 lbs and with restricted visibility to the rear shall be equipped with an operational audible backup alarm. Any vehicle with a non-operational backup alarm shall be taken out of service until the alarm is repaired.

All vehicles and equipment within the contract limits and on the roadway shall be equipped with a rotating amber or flashing Light Emitting Diode (LED) beacon visible from all directions for a minimum of 1,000 feet during daylight. Flashing LED beacons shall meet the requirements of SAE J845 Class 2. Strobe lights shall not be used.

All trucks and trailers with a GVWR greater than 10,000 lbs shall display retro-reflective markings in compliance with Code of Federal Regulations 49 CFR 393.11- Lamps and Reflective Devices. The markings need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the body or trailer. The centerline of the sheeting shall be between 15 inches and 60 inches above the ground. All other construction equipment shall display similarly compliant markings on the front and rear (100 square inches per end minimum), as practicable.

**G. Barrier/Shadow Vehicles.** Barrier/Shadow vehicles shall weigh a minimum of 18,000 lb and shall be equipped with a Type B or Type C Arrow Panel. Ballast may be used to bring a lighter vehicle up to the indicated weight provided the ballast is securely contained within an enclosed body or otherwise securely fastened to the vehicle such that the ballast will not separate from the vehicle upon impact. Where the preconstruction posted speed limit is 55 mph or less, barrier/shadow vehicles shall be equipped with a Test Level-2 truck mounted or trailer mounted impact attenuator. Where the preconstruction posted speed limit is more than 55 mph, barrier/shadow vehicles shall be equipped with a Test Level-3 truck mounted or trailer mounted impact attenuator. Impact attenuators meeting the requirements of NCHRP 350 Test Level 3 are also acceptable as Test Level 2 devices.

Where a barrier vehicle remains stationary for extended periods of time, the Contractor may utilize a barrier trailer in lieu of a barrier vehicle. A barrier trailer is a trailer that may be detached from the tow vehicle and that meets barrier vehicle weight, arrow board, attenuator, and placement distance requirements.

**H. Construction Signs.** Fabrication of all components shall produce a finished sign panel. Holes may be punched or drilled. Edges shall be smooth and true and free from burrs or ragged breaks. Sign

panels, including face shape, color, dimensions, and characters shall be fabricated using colors, character series, character sizes, symbols, route shields and borders as shown in the MUTCD or in the contract documents.

**1. Sign Panels.** Modification of sign legends by overlaying an existing legend with a revised legend, changing a single word or distance, such as changing LEFT to RIGHT or 1000 to 1500 will be permitted if the overlay is a match to the rest of the sign in terms of legend size and type, sheeting color and retro-reflectivity. The overlay shall be firmly adhered to the underlying panel. Any such overlays shall provide a visual match to the rest of the sign when viewed from a distance of 100 feet or greater during all periods in which the sign will be used.

*a. Rigid Sign Panels.* Rigid sign panels shall be aluminum, fiberglass, plywood, or lightweight plastic. All construction sign faces on rigid panels shall conform to §730-05 *Retro-Reflective Sign Sheeting NYSDOT Class A* sheeting. Characters including letters, numerals, route shields, symbols, logos, and borders shall conform to §645-2.02 *Sign Panels - E. Sheeting Sign Characters*.

*b. Flexible Sign Panels.* Flexible sign panels shall be a solid, fluorescent-orange, durable elastomeric material. Flexible panels fabricated from mesh will not be allowed. Flexible sign panels shall be mounted on supports with adequate bracing, so as to minimize flutter and to support the intended shape of the sign.

**2. Mounting Temporary Signs.** Temporary sign supports, except those located beyond the deflection distances of guide rail or temporary barrier as given in Table 619-6 *Guide Rail & Concrete Barrier Standard Deflection Distances* or otherwise protected against impact by errant vehicles, shall meet the following requirements for portable or fixed supports. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. All wood supports shall be painted white.

*a. Portable Temporary Sign Supports.* Ballast used to stabilize supports shall be bagged sand or other suitable material and shall be located at ground level. Portable supports shall be a configuration which is NCHRP 350 approved or be constructed in accordance with a Standard Sheet(s).

*b. Fixed Temporary Sign Supports.* The Contractor shall provide NCHRP 350 approved Type A, Type B or wooden sign posts in accordance with §730-19 *Temporary Wooden Sign Posts*, §730-24 *Type A Sign Supports*, or §730-25 *Type B Sign Supports* as appropriate.

**3. Sign Covers.** Covers used to inactivate unneeded construction signs shall be a single dark color, opaque material containing no wording or images. Rigid covers shall match the size and shape of the sign panel(s). Fabric sign covers may require more than one layer of fabric to prevent legibility of the sign being covered. Rigid Lightweight panels used as covers shall meet the requirements §730-03 *Temporary Rigid Lightweight Sign*. Signs hinged on the back side of the sign face to fold at the center and completely cover the sign face may be used.

**I. Arrow Panels.** Arrow panels shall be in accordance with §729-15 *Arrow Panels*.

**J. Channelizing Devices.** Drums shall be in accordance with §729-01 *Drums*. Standard cones, tall cones and extra tall cones shall be in accordance with §729-02 *Cones*. Temporary tubular markers shall be in accordance with §729-03 *Temporary Tubular Markers*. Standard and oversized vertical

panels shall be in accordance with §729-04 *Vertical Panels*. Type II construction barricades shall be in accordance with §729-07 *Type II Construction Barricades*.

**K. Pavement Edge Drop-off Protection.** (None Specified)

**L. Flagging and Traffic Control.** Hand signaling devices used to control traffic shall meet the requirements of the MUTCD. The standard signaling device shall be STOP/SLOW signal paddles in accordance with §729-05 *Stop/Slow Paddles*. Red signal flags shall be a minimum of 24 inches x 24 inches. Automated Flagging Assistance Devices shall be in accordance with §729-19 *Automated Flagging Assistance Devices*. Portable traffic signals shall be in accordance with §729-20 *Portable Traffic Signals*.

**M. Maintain Existing Mailboxes.** (None Specified)

**N. Contract Site Patrol.** (None Specified)

**619-2.03 Basic Work Zone Traffic Control (Daily Operations).** (None Specified)

**619-2.04 Temporary Business Signs.** Temporary business signs shall conform to the MUTCD. Sign panels shall be in accordance with 619-2.02H.1. *Sign Panels*, except that the panels shall be white on a blue background. Supplemental arrows, as required, shall be white on a blue background (M5-1 to M6-2). Temporary business signs shall be mounted on temporary sign supports.

**619-2.05 Covering or Removal of Pavement Markings.** Tape used to cover existing pavement markings shall be non-reflective, pavement marking masking tape, substantially similar in color to the pavement surface, in accordance with §727-06 *Removable Pavement Tape*.

**619-2.06 Temporary Pavement Markings.** Temporary pavement markings shall consist of removable raised pavement markers in accordance with §727-02 *Removable Raised Pavement Markers*, or removable pavement tape in accordance with §727-06 *Removable Pavement Tape*, or removable wet-night reflective tape in accordance with §727-07 *Removable Wet-Night Reflective Tape*, or traffic paint in accordance with §727-09 *Traffic Paint* and §727-05 *Glass Beads for Pavement Markings*, or temporary overlay markers in accordance with §729-21 *Temporary Overlay Markers*.

**619-2.07 Interim Pavement Markings.** Interim pavement markings shall consist of traffic paint in accordance with §727-09 *Traffic Paint* and §727-05 *Glass Beads for Pavement Markings*, epoxy paint in accordance with §727-03 *Epoxy Paint* and §727-05 *Glass Beads for Pavement Markings*, removable pavement tape in accordance with §727-06 *Removable Pavement Tape*, removable wet-night reflective tape in accordance with §727-07 *Removable Wet-Night Reflective Tape*. Interim pavement markings shall be supplemented, where specified, with removable raised pavement markers in accordance with §727-02 *Removable Raised Pavement Markers*.

**619-2.08 Temporary Rumble Strips.**

**A. Raised Asphalt Rumble Strips.** Raised asphalt rumble strips shall be formed from 6.3 or 9.5 hot mix asphalt. Asphalt Emulsion Tack Coat shall be used to adhere the rumble strip to the existing pavement.

**B. Raised, Removable-Tape Rumble Strips.** Removable-tape rumble strips shall be formed from black, non-reflectorized, removable pavement-marking tape. Raised, removable-tape rumble



strips shall have a minimum width of 6 inches, measured in the direction of traffic, with sufficient layers of tape such that each finished rumble strip has a thickness of 3/8 inches  $\pm$  1/8 inch.

**C. Raised, Preformed Rumble Strips.** Raised, preformed rumble strips shall be manufactured specifically as temporary rumble strips. Raised, preformed rumble strips shall have a minimum width of 4 inches, measured in the direction of traffic, with a thickness of between 1/4 inch and 1/2 inch.

**D. Saw-Cut Rumble Strips.** Saw-cut rumble strips shall have a width of 4 inches  $\pm$  1/2 inch measured in the direction of traffic. The depressions shall have a rectangular cross section with a depth of 3/8 inches  $\pm$  1/8 inch.

**E. Milled-in Rumble Strips.** Milled-in rumble strips shall have a nominal width of 6 inches measured in the direction of traffic. The depressions shall have a semicircular, concave cross section with a depth of 3/8 inches  $\pm$  1/8 inch.

**F. Removing Temporary Rumble Strips.** Rumble strip depressions shall be filled in with a 6.3 or a 9.5 hot mix asphalt meeting the requirements of Section 402, Hot Mix Asphalt (HMA) Pavements.

**619-2.09 Interim Tubular Markers.** Interim tubular markers shall be in accordance with §729-03 *Temporary Tubular Markers*.

**619-2.10 Portable Variable-Message Signs (PVMS) & Truck Mounted Variable Message Signs (TMVMS).** Portable Variable-Message Signs shall be in accordance with §729-16 *Portable Variable-Message Signs (PVMS)*. Truck Mounted Variable Message Signs (TMVMS) shall be in accordance with §729-22 *Truck Mounted Variable Message Signs*. When a TMVMS is used as an arrow board, it shall comply with 729-15 *Arrow Panels*.

**619-2.11 Type III Construction Barricades.** Type III construction barricades shall be fabricated in accordance with §729-08 *Type III Construction Barricades*. All barricades used at night shall be equipped with warning lights in accordance with §729-18 *Warning Lights*.

**619-2.12 Temporary Positive Barrier.** Temporary positive barrier segments shall be precast concrete units in accordance with the Standard Sheets or steel or concrete barrier meeting the approved Materials Details of the products on the Department's Approved List. All temporary concrete barrier supplied after January 1, 2015 shall be produced in accordance with the requirements of §704-05 *Precast Concrete Barrier* and shall have a legible permanent marking. Temporary concrete barrier supplied prior to January 1, 2015 which was not produced in accordance with the requirements of §704-05 *Precast Concrete Barrier*, shall be material certified in accordance with specific Standard Sheets or Materials Details used for fabrication.

Warning lights for temporary barrier shall be in accordance with §729-18 *Warning Lights*. Where warning lights are not required, temporary barrier segments shall be delineated using reflective panels covered with §730-05 *Retro-Reflective Sign Sheeting NYSDOT Class A* sheeting, approximately 3 x 6 inch, having a minimum area of 18 square inches. Where warning lights are required, barrier need not be delineated with panels. Reflective pavement marking material applied to the face of the barrier shall not, by itself, be considered acceptable delineation. Where transitions between Temporary Concrete Barrier and box beam are required, the box beam shall be in accordance with the requirements of §710-21 *Box Beam Guide Railing and Median Barrier*. Where required, the Transition End Pieces shall be precast concrete units in accordance with the Standard Sheets and shall be produced in accordance with the requirements of §704-05 *Precast Concrete Barrier* with a legible permanent marking.

Where transitions between Temporary Concrete Barrier and Corrugated Beam are required, the corrugated beam shall be in accordance with the requirements of §710-20 *Corrugated Beam Guide Railing and Median Barrier*.

**619-2.13 Temporary Glare Screen.** Temporary glare screen shall be in accordance with §729-17 *Temporary Glare Screens*.

**619-2.14 Temporary Impact Attenuator.** Temporary impact attenuators shall be in accordance with §729-10 *Temporary Impact Attenuators - Redirective* or §729-11 *Temporary Impact Attenuators - Gating*.

**619-2.15 Temporary Sand Barrel Arrays.** Temporary sand barrels shall meet the requirements of §729-13 *Temporary Sand Barrels*. Sand fill shall meet the material requirements of §703-06 *Cushion Sand* or §733-15 *Sand Backfill*. Deicing material shall meet the requirements of §712-03 *Sodium Chloride*.

**619-2.16 Vehicle Arresting Barrier (VAB).** Vehicle arresting barriers shall meet the requirements of §729-14 *Vehicle Arresting Systems*. Portland Cement Concrete used for bases shall be Class A or C, in accordance with §501 *Portland Cement Concrete – General*, except that requirements for automated batching shall not apply.

**619-2.17 Maintain or Modify Traffic Signal Equipment.** All traffic signal hardware, including but not limited to wire, cable, conduit, pull boxes, switch packs, modules and relays, detectors, signal heads, poles, and pedestrian push buttons used to maintain proper operation, shall meet the applicable requirements of §680 *Traffic Signals*. Materials which will be permanently incorporated into the work shall be in accordance with §680 *Traffic Signals*.

**619-2.18 Temporary Traffic Signals.** Equipment for temporary traffic signals shall meet the requirements of Section §680 *Traffic Signals*, except that used equipment in good operating condition may be furnished, and for which material certifications are not required. All span wire, inductance-loop wire, shielded lead-in cable, traffic signal cable, and other wire used for temporary traffic signals shall be new material. Portable traffic signals shall be in accordance with §729-20 *Portable Traffic Signals*.

All other equipment for temporary traffic signals shall meet the requirements of §680 *Traffic Signals* except for the following modifications:

**A. Temporary Poles.** Temporary timber poles shall be ANSI O5.1, Class 2, treated with an appropriate waterborne wood preservative. Preservative retention shall be appropriate for the species when used in ground-contact application.

**B. Signal Controller.** The signal controller may be either solid-state or electro-mechanical.

**C. Traffic Signal Heads.** The materials and painting requirements of §724-04 *Vehicular and Pedestrian Traffic Signal Heads* shall not apply except that the signal head housing shall be dark green.

**D. Conflict Monitor.** Means shall be provided to prevent the signal from displaying indications which will result in two or more conflicting traffic movements being permitted simultaneously.

**619-2.19 Nighttime Operations.** (None Specified)

**619-2.20 Traffic Control Supervisor.** (None Specified)

**619-2.21 Temporary Structures and Approaches.** When specific details and materials are shown in the contract documents for temporary structures and approaches, substitutions or alterations may be permitted if approved by Deputy Chief Engineer (Structures) (DCES).

When specific materials are not shown in the contract documents, the Contractor shall assume all liability and responsibility for certifying that all materials required to complete the work conform to the AASHTO Standard Specifications for Highway Bridges or NYSDOT Load and Resistance Factor Design (LRFD) Bridge Design Specifications or NYSDOT Standard Specification, Construction and Materials, unless otherwise approved by the DCES.

If the Contractor proposes to fabricate/construct the temporary structure with used materials, the Contractor shall include with his submittal for the temporary structure, documentation that all primary member material meets the physical properties required by the design. In the absence of record plans, or other valid material certification for the used materials, physical testing shall be performed. The type of physical testing and the results of the testing shall be documented and submitted with the design computations. Excluded from the documentation and testing of physical properties provision are proprietary structures.

Used material shall not be furnished for fracture-critical members. Mill certifications shall be provided for all fracture critical material. Excluded from these fracture-critical provisions are pedestrian and pre-engineered (fabricated) proprietary structures

**619-2.22 Pavement Patching.** In general, hot mix asphalt (HMA) is suitable for all pavement surfaces. During winter months when HMA is not available, a bituminous cold-patch material shall be used.

**619-2.23 Mailboxes.** Materials used shall meet the requirements of the U.S. Postal Service.

### 619-3 CONSTRUCTION DETAILS

**619-3.01 General.** The Contractor shall designate a work zone traffic control competent person who has the primary responsibility and sufficient authority for implementing the work zone traffic control plan and other safety and mobility aspects as necessary. The Contractor's work zone traffic control competent person shall be appropriately experienced and adequately trained in traffic control operations by recognized training programs, including the American Traffic Safety Services Association (ATSSA) "Traffic Control Supervisor", the National Safety Council, unions, or construction industry associations, or by an individual instructor from such a program in accordance with the level of decisions that the individual will be required to make, reflecting current industry practices and Department requirements.

The Contractor shall generally maintain a traveled way suitable for moving traffic, in accordance with the contract documents and ensure construction equipment, vehicles, and materials are safely stored beyond the clear zone or behind protective barrier during non-working hours so as not to constitute a hazard to vehicles, bicycles and pedestrians. Construction operations shall be conducted to ensure a minimum of delay to traffic. Stopping traffic for more than 5 minutes shall not be permitted unless specifically authorized in the contract documents or in writing by the Engineer. All operations shall be carried out in a manner that provides workers with safe access to the worksite and protects workers from moving traffic. The work zone traffic control competent person shall routinely inspect all work zone traffic control equipment and devices to make sure they are in a safe operating condition in accordance with §619-3.02N *Contract Site Patrol*. Unless otherwise noted, temporary items supplied in accordance with this section shall remain the property of the Contractor.

Where pedestrians are not prohibited from the street or highway, pedestrian traffic shall be maintained to allow their safe passage as shown in the contract documents. Where sidewalks, walkways, or shoulders must be temporarily closed to facilitate construction operations, safe pedestrian passage shall be maintained on at least one side of the roadway at all times, unless other temporary pedestrian

accommodations are provided in the contract documents or are approved by the Engineer. Where pedestrian access is prohibited, workers shall not cross or enter travel lanes open to traffic.

The requirements in this section refer to posted speed limits. If prevailing or operating speeds for a highway exceed the preconstruction posted limits, the contract documents may direct the Contractor to assume that the preconstruction posted speed limits are different than posted.

**619-3.02 Basic Work Zone Traffic Control.** The Contractor shall control traffic so that a person who has no knowledge of conditions may safely and with a minimum of discomfort and inconvenience ride, drive, or walk, day or night, over all or any portion of the highway and/or structure under construction where traffic is to be maintained.

The Contractor shall cease operations and restore the traveled way to safe operating condition during any specific periods listed in the contract documents, at such times as traffic renders conditions unsafe to continue work, and during periods of darkness (before sunrise or after sunset), fog, snow or rain, high winds, or other inclement weather that renders conditions unsafe to continue work, for either the traveling public or the workers. The Engineer will determine when traffic or weather conditions render work operations unsafe.

**A. Surface Condition, Debris, Drainage and Dust Control.** The traveled way, sidewalks and pedestrian walkways shall be kept reasonably smooth and hard at all times, and shall be well drained and free of potholes, bumps, irregularities, and depressions that hold water. Except when construction operations necessitate disturbance of the normal surface, the Contractor shall maintain the pavement surface in such a condition as to permit the safe, comfortable passage of vehicles at the posted speed limit. A satisfactory riding surface shall be maintained both when work is underway, and when work is inactive. Special attention shall be given to maintenance of the traveled surface during hours of inactivity, including nights, weekends, holidays, and the winter season.

Milling operations shall be conducted to prevent pavement runoff from collecting along milled joints. Bumps and transverse irregularities shall be eliminated to the extent practical. Pavement joints and milling rebates resulting in longitudinal or transverse vertical faces exceeding 1 inch in height that would be exposed to traffic during non-work hours shall be sloped or tapered with temporary patches or shims providing a taper rate in accordance with Table 619-1 *Required Treatment for Transverse Bumps*.

Where longitudinal tapered wedge paving joints are used, temporary pavement markings shall be provided prior to reopening lanes to traffic. The joints may be left open to traffic provided traffic is not expected to frequently change lanes, and UNEVEN LANES (W8-11) signs are posted in advance of the condition, posted at each ramp and roadway intersection and repeated every ½ mile, supplemented with NEXT [X] MILES (W7-3aP) auxiliary signs.

Transverse bumps or vertical faces, unpaved surfaces, milled or grooved pavement, rough pavement, and other surface irregularities 1 inch or more in height shall be adequately sloped or tapered, or BUMP (W8-1) or other appropriate warning signs shall be posted in advance of the condition. A Type 1 Object Marker (OM1-3) or a drum with a flashing warning light shall be installed on the right side of the roadway at the bump or other condition. On expressways and freeways, an object marker or a drum with a flashing warning light shall be installed on both sides of the roadway.

Where traffic will be riding on milled pavement, the Contractor shall install GROOVED PAVEMENT (W8-15) signs on the approaches. On multilane highways where only one lane in a direction is milled and multiple lanes are open to traffic, the Contractor shall supplement the GROOVED PAVEMENT sign with a black on orange LEFT LANE (M5-4), CENTER LANE (M5-5) or RIGHT LANE (M5-6) panel below the warning sign. Where only an entrance or exit ramp is milled, the Contractor shall sign the mainline with a GROOVED PAVEMENT sign and a supplemental ON RAMP (W13-4) panel.

Where both BUMP and GROOVED PAVEMENT signs are warranted, the GROOVED PAVEMENT sign shall be installed 500 feet upstream of the BUMP sign in non-urban areas, and 300 feet upstream in urban areas. Where the posted speed limit is 45 mph or higher, the Contractor shall place a portable variable message sign (PVMS) in advance of pavement that has been milled or grooved and is open to traffic, warning motorcycle riders to use caution. The PVMS will be paid for separately.

For expressways where the posted speed limit is 45 mph or higher, the Contractor shall not leave milled or grooved pavement for more than 7 calendar days before placement of the next pavement course.

The Contractor shall keep the traveled way, sidewalks, and walkways free of construction materials and foreign objects that fall from vehicles or equipment. Materials spilled by, dropped from, or tracked by traffic or by any vehicle used in the Contractor's operations along or across any public traveled way shall be removed immediately.

The Contractor shall keep all surface drainage facilities operative at all times. Positive drainage shall be provided at all times, even during grading operations and periods of accumulated plowed snow, to adequately drain the traveled way and the remainder of the right-of-way areas. Maintaining positive drainage shall include cleaning of drainage grates on roadway pavements. Cleaning of drainage structures and drainage pipes of material not deposited due to the Contractor's operations will be paid for separately. Repair of drainage structures will be paid for separately.

Dust control measures shall be applied to control dust resulting from traffic on unpaved surfaces and from Contractor operations on or adjacent to the roadway. Dust control shall be adequate to prevent dust which hinders driver visibility or which creates a nuisance condition for property owners and residents adjacent to the contract. Dusty conditions resulting from the Contractor's operations may be corrected by the use of calcium chloride and/or water. If used, water shall be distributed uniformly using a suitable spray head or spray bar.

<b>TABLE 619-1 REQUIRED TREATMENT FOR TRANSVERSE BUMPS</b>			
<b>Height of Bump (in)</b>	<b>Anticipated Exposure Time (Calendar Days)</b>	<b>Posted Speed ≤ 45 mph</b>	<b>Posted Speed &gt; 45 mph</b>
<b>1 to 6</b>	≤ 7	6:1	10:1
	> 7	15:1	30:1

**B. Seasonal Operations and Snow and Ice Control.** The Contractor shall maintain the traveled way in such a condition and conduct operations in such a manner that snow and ice may readily be controlled by others as and when necessary, and in such a manner that proper drainage is provided for the melting of snow banks resulting from normal plowing. The Contractor will not be responsible for snow and ice control on the pavement, shoulder, or sidewalks which are not restricted by construction operations and open to the public

During periods of seasonal shutdown, the traveled way shall be maintained in an acceptable manner for travel, and all traffic control devices and safety features maintained in a safe, operable condition. All construction signs and temporary traffic control devices that are not needed during shutdown periods shall be covered or removed.

**C. Maintain Public Access.** The Contractor shall provide and maintain at all times safe and adequate ingress and egress for intersecting roads, residences, business establishments, adjacent properties, bus stops and other transportation facilities for vehicles, pedestrians and bicycles; at existing or at new access points, consistent with the work, unless otherwise authorized by the Engineer. Whenever construction operations disrupt or interfere with normal traffic patterns, intersections, business establishment access points, and driveways shall be clearly marked using channelizing devices.

A ROAD CLOSED (R11-2) sign on a temporary sign support and Type III construction barricades with warning lights shall be used whenever an entire roadway or ramp is closed to traffic.

Where pedestrian facilities exist, or where pedestrian traffic is reasonably anticipated, the Contractor shall maintain pedestrian access on at least one side of the highway or street at all times, in accordance with the contract documents and the MUTCD. Where an existing pedestrian facility is disrupted, closed or relocated, the temporary facility shall include accessibility features consistent with the features in the existing pedestrian facility. Pedestrian access may be provided using existing pedestrian facilities, temporary sidewalks or walkways, or alternate paths. Where a sidewalk is closed, it shall be marked with a Type II or Type III construction barricade and a SIDEWALK CLOSED (R9-9) sign. Advance warning signs and directional guidance shall be provided to direct pedestrians to alternate paths and crosswalks and to alert motorists. Where bus service is maintained, the Contractor shall provide suitable areas or locations for the loading and unloading of passengers.

Potentially hazardous areas adjacent to sidewalks, walkways, or other areas used by pedestrians shall be protected to prevent pedestrian intrusion in accordance with ' 107-05F. *Restricted Areas*.

Open sidewalks and walkways shall be maintained and kept smooth and free from holes, obstructions, and tripping hazards. Surfaces shall consist of pavement, firmly compacted granular material, or other surfaces noted in the contract documents or approved by the Engineer. The width of the temporary facility shall match that of the existing facility where practicable. When it is not possible to meet the minimum width of 5 ft. for the entire length of the facility, a 5 ft. by 5 ft. passing space should be provided every 200 ft. Construction materials, vehicles, equipment, debris, temporary sign supports or other materials shall not be placed or stored on open sidewalks or walkways unless expressly shown in the contract documents or approved by the Engineer.

Where bicycles are not prohibited from the highway, adequate accommodations for bicyclists shall be maintained in the travel lanes, on the shoulder, or on alternate paths or facilities.

***D. Maintain Existing Roadside Signs, Delineators and Markers.*** Existing Department authorized signs, delineators, markers and their supports within the contract limits shall remain under the control and jurisdiction of the Engineer. Signs not authorized by the Department shall be removed from the right of way, as directed by the Engineer, in accordance with Section 647 *Removing, Storing and Relocating Signs*.

***1. Maintenance.*** Existing signs, delineators, markers and their supports shall be maintained by the Contractor. Adequate visibility of route markers and directional signing shall be provided for drivers at all times. If relocation of route markers and directional signing is necessary to accommodate construction operations, the temporary or new locations shall be subject to approval by the Engineer. Existing roadside delineators shall be removed or relocated only to the minimum extent necessary to accommodate the work under the contract. Where contract operations require the temporary removal of existing delineators to facilitate work operations, temporary roadside delineation consisting of the existing delineators, temporary delineators, or channelizing devices shall be in place each night and at any time work operations at that location are suspended. Temporary devices shall be placed at the outer edge of the shoulder at a spacing similar to the existing delineator spacing.

***2. Storage.*** Existing signs, delineators, markers, and their supports which directly interfere with the construction operations shall be removed, stored, protected, cleaned and replaced in accordance with the contract documents and the provisions of Section 647 *Removing, Storing and Relocating Signs* and will be paid for separately. Existing signs, delineators and markers removed for the Contractor's convenience shall be stored, cleaned and replaced at no additional cost to the State. Existing signs, delineators and markers lost or damaged due to negligence of the Contractor shall be replaced at no additional cost to the State.

**E. Maintain Existing Guide Rail, Median Barrier, and Bridge Rail.** When construction operations require the temporary removal of existing bridge rail, guide rail or median barrier; or when existing rail will be removed and replaced with new rail, the Contractor shall schedule operations to minimize the time period that rail is not installed. Unless otherwise specified in the contract documents, guide rail or median barrier shall be replaced or the location otherwise protected within 14 calendar days.

Bridge rail systems shall be maintained in service at all times on any structure on which vehicle or pedestrian traffic is maintained, unless a temporary barrier is installed, or other means are used to ensure that vehicles, bicyclists and pedestrians are not exposed to the unprotected edge of a bridge.

During non-work hours when traffic is being maintained on the facility, all temporary ends (free ends) of guide rail, median barrier and bridge rail shall be temporarily terminated and marked with a channelizing drum or object marker equipped with a Type A flashing warning light. Corrugated beam guide rail and median barrier, and heavy-post, blocked-out, corrugated beam guide rail and median barrier shall be temporarily terminated by having the exposed ends (free ends) dropped to the ground and pinned. The approach ends of box beam guide rail, median barrier and bridge rail shall be temporarily terminated with box beam guide rail end assemblies utilizing two splice plates and the proper number of bolts per connection. No posts for anchorages will be required. Special temporary splice plates are required to adapt box beam guide rail end assemblies to box beam median barriers.

During any overnight period when existing guide rail or median barrier is temporarily removed, the Contractor shall install channelizing devices in the location where the guide rail or median barrier was removed in accordance with §619-3.02J.6. *Removed Existing Guide Rail or Median Barrier.*

**F. Construction Vehicles and Equipment.** All construction vehicles and equipment operating within the contract limits, whether in the work space, in the traffic space, in spoil areas, in storage areas, or any other areas under the contract, shall be operated at all times with due consideration for the safety of the public and workers.

All vehicles and equipment within the contract limits and on the roadway shall operate a rotating or flashing amber beacon. If visibility of the beacon is blocked by a portion of the vehicle or equipment, additional beacons shall be provided. Beacons shall be mounted in a manner which does not cause glare for the driver or operator. Short-term delivery vehicles not equipped with rotating or flashing amber beacon shall display four-way emergency flashers when in the temporary traffic control zone.

Other than vehicles registered and meeting all applicable requirements of the NYS Vehicle and Traffic Law, no construction vehicle or equipment used in the performance of the work shall be permitted to operate in travel lanes or shoulders open to traffic unless proper traffic control devices and other safety measures are in place to warn drivers of the presence of the equipment.

On any highway where the posted speed limit is 45 mph or higher, no construction vehicle or equipment shall operate in a travel lane or shoulder open to and unimpeded by traffic at a speed less than 15 mph slower than the posted speed limit unless followed by a vehicle equipped with flashing warning lights and *SLOW MOVING VEHICLE* (W21-4) sign on the rear.

The Contractor shall ensure that all construction vehicles and equipment are safely stored beyond the clear zone during non-working hours so as not to constitute a hazard to vehicles and pedestrians, unless protected by traffic barrier.

**G. Barrier Vehicles/Barrier Trailers/Shadow Vehicles.**

**1. Barrier Vehicles.** The Contractor shall provide barrier vehicles to guide traffic and protect workers at the beginning of stationary shoulder closures, lane closures and other stationary work zones in accordance with the contract documents.

When located in the taper of a lane closure and another arrow panel is not present, arrow panels on barrier vehicles shall be operated in the appropriate flashing arrow mode. For all other applications, arrow panels shall either display the four-corner flashing caution mode, or shall be

turned off. Barrier vehicles should normally be unoccupied, with transmission in gear, parking brakes set and wheels straight, except when being moved. Barrier trailers should have parking brakes set and arrow panels shall be operated in the appropriate flashing arrow mode.

Barrier vehicles and barrier trailers shall be moved if necessary as the work progresses. The placement distance (distance a barrier vehicle or barrier trailer is located in advance of the first workers or hazard) shall be based on Table 619-2 *Placement Distance for Barrier/Shadow Vehicles*.

<b>TABLE 619-2 PLACEMENT DISTANCE FOR BARRIER/SHADOW VEHICLES</b>				
<b>Posted Speed Limit (mph)</b>	<b>Placement Distance (ft)</b>			
	<b>Barrier Vehicles</b>			
	18,000 lb		24,000 lb	
	Minimum	Maximum	Minimum	Maximum
> 55	100	200	100	200
45- 55	100	200	80	160
<45	80	160	50	100
	<b>Shadow Vehicles</b>			
> 55	230	325	180	280
50 - 55	180	280	150	250
≤ 45	100	200	100	200

**2. Shadow Vehicles.** For posted speed limits of 30 mph or higher, the Contractor shall provide shadow vehicles to guide traffic and protect workers conducting mobile or short duration work operations except where the travel lane is closed to traffic by traffic barriers or by channelizing devices., including, but not limited to, pavement marking application, pavement marking removal and sweeping

When located in an open travel lane of a multilane roadway, the shadow vehicle shall display the flashing arrow panel in the appropriate mode. When located in a travel lane closed by barrier or channelizing devices, on a shoulder, otherwise not in an open travel lane, or on a two-lane, two-way roadway, the arrow panel shall either display the four-corner flashing caution mode or be turned off.

The shadow vehicle shall be moved as necessary to keep pace with the work operations. The placement distance (distance the shadow vehicle is in advance of the first workers or hazard) shall be as shown in Table 619-2 *Placement Distance for Barrier/Shadow Vehicles*.

When mobile or short duration work operations occupy a long distance of a travel lane not closed to traffic by barrier or channelizing devices, such that traffic may reenter the lane between work operations, the Contractor shall provide additional shadow vehicles for any gaps in the operation of 500 ft or more.

**H. Construction Signs.** The Contractor shall install and maintain construction signs in good condition to adequately and safely inform and direct motorists, bicyclists and pedestrians. Existing and construction signs shall indicate actual roadway conditions, and shall be covered, uncovered, changed, relocated, or removed immediately to reflect current conditions. Construction signs shall be covered or removed when they no longer indicate actual conditions.

The Contractor shall provide measures to protect workers during placement and removal of construction signs adequate for the prevailing speed, volume of traffic and roadway geometry where the work is to occur. Such protection may include, but is not limited to, the use of flaggers, spotters, and shadow vehicles equipped with truck-mounted or trailer mounted attenuators. Where pedestrian access is prohibited, workers shall not cross or enter travel lanes open to traffic.



All signs shall be kept clean, mounted at the required height on acceptable supports, and installed in the proper position, alignment and orientation so as to give maximum visibility. Construction signs will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Work Zone Traffic Control Devices*. When auxiliary panels are mounted above or below a warning or regulatory sign, they shall not cover any part of the warning or regulatory sign. Signs shall be placed so that each sign is visible at night, at the desired distance, without being obscured by another sign, existing features on the highway, or foliage. The faces of stored signs shall not be visible to traffic in any direction, regardless of the orientation of the sign.

**1. Sign Panels.** Panels shall be flat and shall not be bowed or warped. Panel shapes shall not be altered, such as trimming corners of diamond shaped panels. If insufficient clearance exists, rectangular and/or smaller signs shall be used to obtain proper clearance. Panels with any wrinkling, delamination, or lack of adhesion of the reflective sheeting or legend will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Work Zone Traffic Control Devices*. Signs shall not bear any advertising message or any other message. A nonretroreflective logo or identifying information of the owner may be located on the back of the sign. The logo shall not exceed 1 square foot. The owner information shall not exceed 2 inches in height.

Flexible, or roll-up, sign panels shall only be used for short-term, daytime use. All flexible sign panels shall be mounted on supports with adequate bracing, so as to minimize flutter and to support the intended shape of the sign. Fluorescent-orange colored flexible sign panels shall be approved by the Engineer prior to and for the duration of their use.

**2. Mounting Temporary Signs.** Unless otherwise noted in the contract documents or in the MUTCD, construction signs shall be mounted on a separate support. In cases where construction signs on an existing support will replace or supplement existing sign(s), they shall be mounted in accordance with the Standard Sheet(s). The type of temporary sign supports used shall be selected by the Contractor. Signs that are erected and removed or relocated on a daily basis, or that must be frequently relocated to adjust to the location of construction operations, may be mounted on portable temporary sign supports. If rigid diagonal bracing is used, the high end of the bracing shall face away from approaching traffic. Signs that are to remain at one location may be supported on fixed temporary sign supports.

Supports for construction signs shielded by barrier or guide rail, and located beyond the deflection distance described in Table 619-6 *Guide Rail and Temporary Concrete Barrier Standard Deflection Distances* are not required to be NCHRP 350 approved.

When not in service, temporary signs mounted on portable temporary sign supports shall be stored in such a manner and location that they do not interfere with or present a hazard to vehicular, bicycle or pedestrian traffic. No signs or supports shall be stored on the traveled way, shoulders or sidewalks during non-working hours. Portable temporary sign supports stored within the clear zone shall be laid flat such that no part of the support is more than 4 inches above the ground. No portable temporary sign supports shall be leaned against or overhang the traffic side of traffic barrier.

All mounting heights are measured from the bottom of the lower sign panel to the nearest edge of pavement or to the ground directly below the sign, whichever results in a higher mounting. Rigid sign panels shall have a minimum mounting height of 5 feet, or a minimum mounting height of 7 feet, where pedestrians or parked vehicles are present. For signs incorporating an auxiliary panel below the primary panel, the minimum mounting heights shall be 4 feet and 6 feet, respectively. For pedestrian regulatory and guide signs the minimum mounting height shall be 4 feet.

Flexible panel and lightweight rigid panel signs shall be mounted at the same height as rigid panel signs, except they may be mounted, when approved by the Engineer, as low as 1 foot when all the following conditions are met:

- a. 1. On two-lane, two-way roadways, or;  
2. When signs are placed on the left and right sides of expressways and freeways.
- b. Where there will be no parked vehicles to obstruct the view.
- c. Where the first warning sign(s) of a work zone warning sign sequence is mounted at a height of 5 feet or higher, and is located in advance of any flexible signs to alert motorists that they are entering a temporary traffic control zone.
- d. When the lower mounting height does not adversely affect visibility of the sign by motorists.

**3. Sign Covers.** Covers for unneeded construction and/or permanent signs shall be attached in such a manner to cover the entire sign face including auxiliary panels above or below the main sign panel. The cover shall be firmly attached to the sign in a secure manner using straps, small hand clamps, small brackets or other means to prevent dislodging. Sign covers shall be maintained in good condition to present a neat appearance and minimize distraction to motorists. Damaged covers which are no longer effective shall be promptly replaced.

Sign covers for permanent signs that are unrelated to work zone traffic control operations will be paid for separately.

**4. State Law Signs.** Signs advising motorists of increased fines or license suspension for speeding within the work zone shall be installed in accordance with the contract documents. The LICENSE SUSPENDED AFTER TWO WORK ZONE SPEEDING TICKETS (NYR9-11) or the FINES DOUBLED FOR SPEEDING IN WORK ZONES (NYR9-12) sign shall be posted in advance of work zones not having a reduced regulatory speed limit. The FINES DOUBLED FOR SPEEDING IN WORK ZONES (NYR9-12) sign shall be posted in advance of work zones having a reduced regulatory speed limit. The state law sign shall be installed approximately 1,000 feet upstream of the first construction warning sign on highways with preconstruction posted speed limits equal to or greater than 45 mph and 300-500 feet upstream of the first construction warning sign on highways with preconstruction posted speed limits of less than 45 mph. For contracts with multiple work zones, the state law sign shall be installed at the aforementioned distances upstream of the ROAD WORK NEXT XX MILES (G20-1) sign or at the contract limits and need not be installed prior to each activity area. If any of the individual activity areas have a reduced regulatory speed limit, the FINES DOUBLED FOR SPEEDING IN WORK ZONES shall be used.

**5. Special Use Work Zone Signs.** Special use work zone signs shall be installed in accordance with the contract documents.

Reduced regulatory speed limits in work zones shall be posted in accordance with contract documents with SPEED LIMIT signs (R2-1) supplemented with WORK ZONE plaques (G20-5aP) of the same width mounted above the speed limit signs. The work zone plaques shall be placed on the same post and as the speed limit signs. REDUCED SPEED LIMIT AHEAD sign(s) (W3-5) shall be posted in advance of the first speed limit sign reducing the speed limit in a work zone.

All reduced regulatory speed limit signs shall be installed on both sides of expressways and freeways. When traffic is reduced to a single lane, reduced regulatory speed limit signs should be installed only on the right side of the highway. Reduced regulatory speed limit signs shall be placed within the work zone activity area at a maximum spacing of ½ mile. Reduced regulatory speed limit signs shall be completely covered or removed, and preconstruction posted speed limit

signs shall be uncovered or replaced, after a work zone activity area is restored. A work zone plaque shall not be mounted above preconstruction posted speed limit signs within a work zone.

The END WORK ZONE SPEED LIMIT signs (R2-12) or the preconstruction posted speed limit sign (R2-1) shall be posted 100 ft beyond the end of a work zone activity area having a reduced regulatory speed limit. An END HIGHER FINES sign (R2-11) shall be placed 200 feet beyond the END WORK ZONE SPEED LIMIT sign.

Where shown in the contract documents, the Contractor shall install BE PREPARED TO STOP (W3-4) signs to inform oncoming traffic of potential stopped, queued or very slow conditions upstream of advanced warning signs. Multiple signs may be installed and covered for later use. A PVMS may be used for the sign or as a supplement.

Each BE PREPARED TO STOP sign shall be mounted on a temporary sign support, and shall be equipped with a pair of orange warning flags. For approaches on expressways and freeways with three lanes or more, both sides of the approach shall be signed unless the median is too narrow to fit the sign and the support.

The BE PREPARED TO STOP signs shall be posted approximately ½ mile in advance of the anticipated end of the queue. If the end of the queue is beyond the sign, the sign location shall be adjusted for the subsequent work day until the desired advance warning reflects typical conditions for that location. If the resulting adjustment places the sign in advance of the first warning sign, the Contractor shall also furnish and place a ROAD WORK (W20-1) sign approximately 1,000 feet in advance of the BE PREPARED TO STOP signs.

**I. Arrow Panels.** The Contractor shall provide, operate and maintain arrow panels, also known as arrow boards, on highways having two or more travel lanes in the same direction, where the posted speed limit is 40 mph or higher, whenever a lane or lanes are closed to traffic and vehicles are required to merge with traffic in adjacent lanes. One arrow panel shall be provided for each lane closed to traffic regardless of the duration. Arrow panels shall be mounted so that the base of the panel is at least 7 feet above the pavement surface. Arrow panels shall be legible continuously from any point within the roadway (inclusive of shoulders) from 1,500 feet in advance of the lane closure taper to the beginning of the lane closure taper. Any arrow panel which cannot provide a sufficiently bright and clearly legible arrow display at any point within the roadway within the above distance shall be immediately repaired or replaced.

Arrow panels shall not be used where they would interfere with the operation of a traffic signal or flasher or where there is an operation controlled by a signal or flagger(s). Arrow panels will not be permitted for alignment changes or lane diversions where the number of through traffic lanes is not reduced, or for any application on two-lane, two-way roadways except in the caution mode.

**J. Channelizing Devices.** Where construction operations obliterate pavement markings, or otherwise change or disrupt the normal traffic pattern, the Contractor shall use channelizing devices to physically separate traffic from portions of the roadway not available for travel; to separate traffic from hazards adjacent to the roadway; to separate opposing or adjacent travel lanes; to mark the location of hazards within or adjacent to the roadway; and to clearly define the intended travel path for vehicles, bicycles, and pedestrians. Spacing of devices shall be sufficiently close at all times to provide clear and adequate guidance to ensure that vehicles, bicycles, and pedestrians follow the intended travel path. Channelizing device spacing requirements are stated in center-to-center distances.

Channelizing devices shall be maintained upright, at proper spacing, in proper alignment and orientation, and kept clean. Channelizing devices used at night shall be retroreflective. Channelizing devices shall not bear any advertising or other message. A non-retroreflective logo or identifying information of the owner may be located on the back, base or top of channelizing devices where it does not obstruct the face, color, or reflectivity. The logo shall not exceed 1 square foot. The owner information shall not exceed 2 inches in height. The Contractor shall make frequent checks

commensurate with traffic conditions to identify and reset channelizing devices dislodged by traffic. Deformed or damaged devices and devices that do not maintain appearance, color, and reflectivity will be evaluated for acceptability in accordance with the American Traffic Safety Services Association (ATSSA) *Quality Guidelines for Work Zone Traffic Control Devices*. Ballast and/or mailboxes shall not be placed on top of a device or at any point above ground level. Ballast rings may be added to traffic cones, or traffic cones may be doubled, with one cone on top of the other, to serve as ballast.

One Type A flashing warning light shall be installed on the first channelizing device in each series of a nightwork shoulder or travel lane closure. One Type A flashing warning light shall be installed on channelizing devices used to mark the location of hazards in or adjacent to the travel lane, including, but not limited to, pavement discontinuities, drainage structures, excavations, fixed objects, and other obstructions and potential hazards remaining at the end of the work shift. Where the placement of numerous Type A flashing warning lights may present a distraction to motorists, flashing warning lights may be eliminated at intermediate locations such as driveway entrances or intersections.

Cones may be used in work zones where workers are not exposed to traffic, where the cones are placed to protect the work, and the placement does not create a hazard for traffic. In this application, cones are not considered channelizing devices.

Channelizing device application is summarized in Table 619-3A *Channelizing Device Application for Short-Term Stationary Work Zones* and Table 619-3B *Channelizing Device Application for Intermediate-Term and Long-Term Stationary Work Zones*. Where permitted, the Contractor may opt to substitute interim tubular markers or Type III construction barricades for other channelizing devices at no additional cost to the State.

**1. Tapers.** Tapers are defined as a transition area where motorists are redirected out of their normal path to a new path, including the tapered portion of lane closures, lane shifts, transitions, crossovers, ramps, intersections, or interchanges. The Contractor shall use drums, oversized vertical panels, or Type II construction barricades to delineate tapers. The Contractor may also use standard cones, tall cones, extra tall cones, and vertical panels for short term work zones during daylight hours only. At stationary work zones where workers are exposed to traffic and the posted speed limit is 40 mph or more, the spacing between channelizing devices shall not exceed 40 feet. Where the posted speed limit is less than 40 mph, the spacing between channelizing devices shall not exceed 20 feet.

**2. Traveled Way (Including Lane and Shoulder Closures).** The Contractor shall use drums, tall cones, extra tall cones, vertical panels, oversized vertical panels, or Type II construction barricades to delineate the traveled way. The Contractor may also use standard cones and vertical panels for short term work zones during daylight hours only. At stationary work zones, where no workers are exposed to traffic or no workers are present, the spacing between channelizing devices shall not exceed 80 feet. At stationary work zones, where workers are exposed to traffic, the spacing between channelizing devices shall not exceed 40 feet. Where necessary to permit ingress or egress by construction vehicles, wider gaps may be provided between channelizing devices, not to exceed the deletion of every fifth device.

At expressway gores, the Contractor shall use drums, tall cones, extra tall cones, oversized vertical panels, or Type II construction barricades. The Contractor may also use standard cones and vertical panels for short term work zones (during daylight hours) only. The Contractor may opt to substitute Type III construction barricades except in locations where they restrict driver vision. The spacing between channelizing devices shall not exceed 20 feet.

At transverse bumps and other hazards on roadways where the posted speed limit is 40 mph or less, the Contractor shall use drums, extra tall cones or oversized vertical panels.

Along lane or shoulder closures, where traffic will be traveling adjacent to the closures, two channelizing devices consisting of tall cones, extra tall cones, drums, vertical panels, oversized vertical panels or Type II construction barricades shall be placed transversely across each closed lane and shoulder at maximum 800 feet intervals except in locations where it would interfere with milling, paving or other ongoing work, to discourage traffic from driving through the closed lane. The Contractor may also use standard cones for short term work zones (during daytime hours) only. The Contractor may opt to substitute one Type III construction barricade for two transverse devices. These transverse devices may be relocated or adjusted as necessary to permit passage of construction vehicles.

**3. Roadway or Pavement Edge.** The Contractor shall use drums, tall cones, extra tall cones, vertical panels, oversized vertical panels, or Type II construction barricades where the work introduces or exposes hazards within the roadway or at the outside edge of the roadway, and pavement edge markings or permanent delineators are not installed. The Contractor may opt to substitute Type III construction barricades. The spacing between channelizing devices shall not exceed 200 feet. If barrier is within 4 feet of the nearest travel lane, barrier delineation at a spacing not exceed 20 feet may be provided in place of channelizing devices.

**4. Roadway Intersections and Commercial Driveway Radii.** The Contractor shall use drums, or extra tall cones to delineate roadway intersections and commercial driveways. The Contractor may also use standard cones, tall cones, and temporary tubular markers for short term work zones during daylight hours only. The spacing between channelizing devices shall not exceed 6 feet. Reduced spacing near roadway intersections and commercial driveways may be necessary to provide clear guidance. Vertical panels, oversized vertical panels, Type II barricades and Type III barricades shall not be used.

A non-signalized intersecting roadway shall be delineated by a new series of channelizing devices, and the series will start with one drum equipped with a Type A flashing warning light, placed along the primary roadway after the intersection.

**5. Residential Driveway Radii.** The Contractor shall use drums, or extra tall cones to delineate residential driveways. The Contractor may also use standard cones, tall cones, and temporary tubular markers for short term work zones during daylight hours only. The spacing between channelizing devices shall not exceed 6 feet. Reduced spacing near residential driveways may be necessary to provide clear guidance. Vertical panels, oversized vertical panels, Type II barricades and Type III barricades shall not be used.

**6. Removed Existing Guide Rail or Median Barrier.** The Contractor shall use drums, tall cones, extra tall cones, temporary tubular markers, vertical panels, oversized vertical panels, Type II construction barricades, Type III construction barricades to delineate the edge of the shoulder or median in locations where guide rail or median barrier was removed. The spacing between channelizing devices shall not exceed 80 feet where the shoulder width is 4 feet or greater, and shall not exceed 40 feet where the shoulder width is less than 4 feet. A minimum of three devices shall be provided for each individual run of guide rail or median barrier that has been removed.

**7. Placing, Maintaining and Removing Channelizing Devices.** The Contractor shall take all necessary precautions to protect the public and workers during the placement, maintenance, and removal of channelizing devices. Warning signs shall be in place in advance of and prior to the start of channelizing device placement, and shall remain in place until after the channelizing devices have been removed.

Channelizing devices shall be set up and removed by properly trained worker(s). The Contractor shall protect workers during placement and removal of channelizing devices, using

measures adequate for the prevailing speed, volume of traffic and roadway geometry where the work is to occur. Protection shall include the use of automatic devices or from protected areas of a vehicle where practicable. Such protection may include, but is not limited to, the use of cone-setting equipment, cone baskets mounted on work vehicles, flaggers, spotters, and shadow vehicles equipped with impact attenuators. Workers placing or removing traffic control channelizing devices onto/from the roadway from the back or side of a moving vehicle shall be protected by a fall restraint system consisting of side racks, harness and lanyard and/or cone basket so that a worker cannot fall off the vehicle and strike the pavement. Workers shall be seated in seats having seatbelts on moving work vehicles when not in the process of placing or removing channelizing devices.

A shadow vehicle shall protect the channelizing device placement or removal operation on multi-lane highways, or a vehicle with a side or front cone basket shall meet the requirements of a shadow vehicle. Vehicles with front mounted cone baskets shall be used only on expressways and freeways traveling in the same direction as traffic.

**TABLE 619-3A CHANNELIZING DEVICE APPLICATION FOR SHORT-TERM STATIONARY WORK ZONES**

Work Zone Provisions		Maximum Device Spacing (center to center)	Channelizing Device									
			Drums	Standard Cones	Tall Cones	Extra Tall Cones	Temporary Tubular Markers	Interim Tubular Markers	Vertical Panels	Oversized Vertical Panels	Type II Barricades	Type III Barricades
Shoulder/Merging/Shifting Tapers	< 40 mph	20 ft.	X	X	X	X			X	X	X	
	≥ 40 mph	40 ft.	X	X	X	X			X	X	X	
One-Lane Taper for Alternating Two-Way Traffic		20 ft.	X	X	X	X			X	X	X	
Longitudinal Lane or Shoulder Closure w/Workers		40 ft.	X	X	X	X			X	X	X	
Longitudinal Lane or Shoulder Closure w/No Workers		80 ft.	X	X	X	X			X	X	X	
Freeway / Expressway Gores		20 ft.	X	X	X	X			X	X	X	O
Marking for Transverse Bumps <sup>1</sup>		N/A	X <sup>2</sup>			X <sup>2</sup>				X <sup>2</sup>		
Transverse Device within Closed Traffic Lane and/or		800 ft	X	X	X	X			X	X	X	O
Roadway edge exposed with no Edgeline or Permanent Delineators		200 ft.	X		X	X			X	X	X	O
Roadway Intersection or Commercial Driveway Radii		6 ft.	X	X	X	X	X					
Residential Driveway Radii		6 ft	X	X	X	X	X					
Removal of existing guide rail	Shoulder width ≥ 4 ft.	80 ft.	X		X	X	X		X	X	X	O
	Shoulder width < 4 ft.	40 ft.										
Pavement Drop offs > 2 in. and < 24 in.		<b>See Table 619-4</b>										
Drop off ≥ 24 in. within 10 ft. of active travel way; Posted speed ≤ 45 mph; Drop off Length ≤ 100 ft.; Not to last longer than 1 work shift		20 ft.	X			X				X		
Closed Roads		N/A										X

Closed Sidewalks	N/A									X	X
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NOTES: X = Allowed Blank = Not Allowed O = Optional at Contractor's expense  
 1 - A Type 1 Object Marker may be used in lieu of channelizing device  
 2 - Channelizing devices shall be equipped with a flashing warning light

<b>TABLE 619-3B CHANNELIZING DEVICE APPLICATION FOR INTERMEDIATE-TERM AND LONG-TERM STATIONARY WORK ZONES</b>												
<b>Work Zone Provisions</b>		<b>Maximum Device Spacing (center to center)</b>	<b>Channelizing Device</b>									
			<b>Drums</b>	<b>Standard Cones</b>	<b>Tall Cones</b>	<b>Extra Tall Cones</b>	<b>Temporary Tubular Markers</b>	<b>Interim Tubular Markers</b>	<b>Vertical Panels</b>	<b>Oversized Vertical Panels</b>	<b>Type II Barricades</b>	<b>Type III Barricades</b>
Shoulder/Merging/Shifting Tapers	<40 mph	20 ft.	X							X	X	
	≥ 40 mph	40 ft.	X							X	X	
One-Lane Taper for Alternating Two-Way Traffic		20 ft.	X							X	X	
Longitudinal Lane or Shoulder Closure w/Workers		40 ft.	X		X	X				X	X	
Longitudinal Lane or Shoulder Closure w/No Workers		80 ft.	X		X	X				X	X	
Freeway / Expressway Gores		20 ft.	X		X	X				X	X	O
Marking for Transverse Bumps <sup>1</sup>		N/A	X <sup>2</sup>			X <sup>2</sup>				X <sup>2</sup>		
Transverse Device within Closed Traffic Lane and/or		800	X		X	X			X	X	X	O
Roadway edge exposed with no Edgeline or Permanent Delineators		200 ft.	X		X	X			X	X	X	O
Roadway Intersection or Commercial Driveway Radii		6 ft.	X			X						
Residential Driveway Radii		6 ft.	X			X						
Removal of existing guide rail	shoulder width ≥ 4	80 ft.	X		X	X	X		X	X	X	O
	shoulder width < 4	40 ft.										
Pavement Drop offs > 2 in. and < 24 in.		<b>See Table 619-4</b>										
Drop off ≥ 24 in. within 10 ft. of active travel way; Posted speed ≤ 45 mph; Drop off Length ≤ 100 ft.; Not to last longer than 1 work shift		20 ft.	X			X				X		
Two-Lane Two-Way Operations on expressways and freeways at	along curves	20 ft.	X							X	X	O
	along tangents	40 ft.										
Two-Lane Two-Way Operations on		40 ft.	X		X	X		X	X	X		

expressways and freeways between Crossovers											
Closed Roads	N/A										X
Closed Sidewalks	N/A								X	X	

NOTES: X = Allowed Blank = Not Allowed O = Optional at Contractor's expense

1 - A Type 1 Object Marker may be used in lieu of channelizing device.

2 - Channelizing devices shall be equipped with a flashing warning light.

**K. Pavement Edge Drop-Off Protection.** A drop-off is an abrupt difference in surface elevation of more than 2 inches at approximately 1V:3H or steeper. In the absence of adequate Traffic Control Plans in the contract documents, the Contractor shall submit alternate Traffic Control Plans to the Engineer for approval at least 30 calendar days prior to proposed work which will create a drop-off of over 24 inches within 10 feet from the edge of the traveled way for durations longer than one shift.

The Contractor shall provide pavement edge drop-off protection in accordance with Table 619-4 *Pavement Edge Drop-Off Protection*. Channelizing devices used to mark drop-offs shall be placed, as practicable, to not reduce the available travel lane width, at the elevation of the open travel lane in order to provide maximum target value and visibility for motorists.

A drop-off of greater than 24 inches within 10 feet from the edge of the traveled way to remain at the end of the work shift shall be separated from traffic with temporary or permanent barrier. For posted speed limit of 45 mph and less, a drop-off of greater than 24 inches within 10 feet from the edge of the traveled way that is 100 feet or less in length will be allowed with channelizing devices consisting of drums, extra tall cones or oversized vertical panels only at a maximum spacing of 20 feet for short durations not to exceed one work shift.

Unless otherwise noted in the contract documents, the Contractor shall begin work to eliminate unprotected drop-offs created by contract work within 7 calendar days of the completion of the work creating the drop-off. Work shall continue in a timely manner until such time as the unprotected drop-off condition is eliminated.

Where pavement edge lines are not provided, channelizing devices shall be preceded by a NO SHOULDER (W8-23) sign, repeated at all ramps and roadway intersections. Signs shall be repeated every ½ mile and supplemented with a NEXT [X] MILES (W7-3aP) plaque where applicable.

Where pavement edge lines are provided, channelizing devices shall be preceded by SHOULDER DROP-OFF (W8-17) signs, repeated at all ramps and roadway intersections. Signing shall be repeated every ½ mile and supplemented with NEXT [X] MILES (W7-3aP) plaque where applicable.

TABLE 619-4 PAVEMENT EDGE DROP-OFF PROTECTION						
Drop-Off Height	Edge Line Pavement Markings	Drum Spacing (feet)	Vertical Panel Spacing (feet)	Tubular Marker Spacing (feet)	Tall Cone Spacing (feet)	Signs
<b>DROP-OFF AT OR WITHIN SHOULDER AREA</b>						
<b>Within 4 ft. from Travel Lane</b>						
2 – 6 in.	Yes	100	100	N/A	N/A	Shoulder Drop-off
	No	40	40	N/A	N/A	No Shoulder
6 - 24 in.	Yes	40	40	N/A	N/A	Shoulder Drop-off
	No	20	20	N/A	N/A	No Shoulder
<b>More than 4 ft. from Travel Lane</b>						
2 – 6 in.	Yes	200	200	100	100	Shoulder Drop-off



	No	100	100	40	40	No Shoulder
6 - 24 in.	Yes	40	40	N/A	N/A	Shoulder Drop-off
	No	40	40	N/A	N/A	No Shoulder
<b>DROP-OFF OUTSIDE OF SHOULDER EDGE</b>						
<b>Shoulder width ≤ 4 ft.</b>						
2 – 6 in.	Yes	100	100	N/A	N/A	Shoulder Drop-off
	No	100	100	N/A	N/A	No Shoulder
6 - 24 in.	Yes	40	40	N/A	N/A	Shoulder Drop-off
	No	40	40	N/A	N/A	No Shoulder
<b>Shoulder width &gt; 4 ft.</b>						
2 – 6 in.	Yes	200	200	100	100	Shoulder Drop-off
	No	100	100	40	40	No Shoulder
6 - 24 in.	Yes	100	100	40	40	Shoulder Drop-off
	No	40	40	N/A	N/A	No Shoulder

**L. Flagging and Traffic Control.** The Contractor shall provide an adequate number of competent flaggers to control traffic when it is necessary to maintain alternating one-way traffic in one lane of a two-lane, two-way roadway, and at all other locations where construction operations, construction vehicles and equipment, and temporary traffic patterns related to the construction operations require positive temporary traffic control for safe, efficient traffic operations. These locations include, but are not limited to, locations where construction traffic enters, exits, or crosses open traffic lanes, locations of temporary stoppage of traffic for work operations, rail crossings, locations requiring slowing of traffic adjacent to work operations, on-ramps with restricted site distance, pedestrian crossings, intersections, and other locations where traffic needs to be alerted to unexpected conditions ahead.

Multiple lane approaches shall be reduced to a single lane prior to a flagger station. Automated flagger assistance devices (AFAD), portable traffic signals, and temporary traffic signals used to control traffic at the Contractor's option in lieu of flaggers shall be at no additional expense to the State.

**1. Flagger Training.** All flaggers shall be adequately trained in flagging operations by recognized training programs, including the American Traffic Safety Services Association, the National Safety Council, unions, or construction industry associations, or by an individual who holds a current certification as a flagger training instructor from such a program. Prior to the start of flagging operations, the Contractor shall provide to the Engineer a list of certified flaggers to be used in the operation, identifying the source of flagger training for each individual. When requested by the Engineer, flaggers shall demonstrate their competency in flagging procedures. Flaggers not competent in flagging procedures shall be retrained or replaced at once.

**2. Flagger Equipment.** Flaggers shall wear orange protective helmets and traffic control apparel in accordance with ' 107-05A. *High Visibility Apparel*. Flaggers shall be appropriately dressed, including apparel that covers the legs, torso and arms with sleeves a minimum of 4 inches long and appropriate footwear. Immodest or sloppy dress will not be permitted. Flaggers shall be equipped with an emergency air horn to alert workers of errant vehicles or other dangerous situations. Where flaggers are not within sight of each other, each flagger shall be equipped with a communication device, such as portable phone or two-way radio. The communication device shall only be used to communicate with other flaggers, other workers, or supervisor(s) regarding the flagging operations. Where the distance between flaggers is more than ½ mile or where

shown in the contract documents, the Contractor shall use pilot cars to lead lines of vehicles through the work zone.

The standard signaling device for flagging operations, where one or more flaggers are controlling a single stream of traffic or two alternating streams of traffic in opposite directions, shall be STOP/SLOW signal paddles. Red signal flags may be used where display of the STOP and SLOW faces in opposite directions may be inappropriate or misleading.

**3. Operational Control.** Flaggers shall be located in a position clearly visible to, but not in the path of, approaching traffic, with an available escape path to avoid an oncoming errant vehicle. The number of flaggers to be furnished for each operation shall be sufficient to provide safe, efficient flow of vehicle and pedestrian traffic. A spotter is not a flagger, and shall only direct construction vehicles or equipment, and shall not direct traffic in any manner.

Work zones utilizing flaggers shall comply with the Standard Sheet for flagger operation and a Flagger symbol (W20-7) sign shall be provided in advance of each flagger.

For control of alternating one-way traffic, one flagger shall be provided at each end of the one-way section, with additional flaggers provided to control traffic entering the one-way section from intermediate intersections and major commercial driveways. Where the length of the one-way section is less than 150 feet, the posted speed limit is less than 40 mph, traffic volumes are such that queues do not develop, and sight distances are adequate, the Contractor may request approval from the Engineer to use a single flagger.

For intersection control, at least one flagger shall be provided for each intersection approach. Where traffic speeds and/or volumes are unusually low, and adequate sight distance is available, such that safe operations can be ensured with fewer flaggers, the Contractor may request approval from the Engineer to use fewer flaggers. When flagging at an intersection with a traffic signal, the signal shall be turned off unless directed otherwise by the Engineer.

The Contractor shall provide enhanced flagger stations consisting of a Flag Tree (6F.57) and additional cones at all approaches to flaggers, in accordance with the Standard Sheet, in order to provide effective advanced warning to motorists. Flag Trees shall display a minimum of 3 orange warning flags, with the flags mounted such that the lowest corners of the flags are at a minimum height of 8 feet. On roadways with posted speed limits less than 40 mph, in locations having obstructed traffic flow, such as those having controlled intersections along the approach or approaches, where conditions do not permit placing the devices in a manner that will provide effective advanced warning to motorists, enhanced flagger stations need not be provided.

Flaggers shall be alert at all times, and shall not stand with their backs to approaching traffic. Flaggers shall only direct traffic to stop, to slow or to proceed, using hand signals to supplement the signaling device in accordance with the flagging procedures shown in the MUTCD. Flaggers shall be provided periodic breaks (minimum 15 minutes every 4 hours) throughout the work day, with competent substitutes provided during breaks to maintain continuous coverage of the flagging operation.

A spotter shall be provided at all locations where construction vehicles or equipment must back across or into open travel lanes, sidewalks, or pedestrian walkways. A spotter shall only direct construction vehicles or equipment, and shall not direct traffic in any manner.

For ongoing flagging operations at a specific location, the Contractor may request approval from the Engineer to substitute portable traffic signals in lieu of flaggers.

**4. Automated Flagging Assistance Devices (AFAD).** AFADs are devices to control traffic through work zones remotely by a single flagger at a central location or at one end of the work zone.

A minimum of 7 calendar days prior to initial deployment of the AFAD system, the Contractor shall submit a traffic control plan to the Engineer, for review and approval, detailing AFAD operation including a list of competent flaggers trained to operate the AFAD. AFADs

shall be used only on two-lane two-way or single lane one-way roadways. AFADs shall not be used where there are intersections and/or commercial driveways or where construction operations within the controlled highway segment frequently disrupt traffic flow. Appropriate flagger apparel and equipment shall be maintained near each AFAD to facilitate flagging in the event of a malfunction or operational need due to frequent disruptions of traffic flow. The Contractor shall immediately provide traffic control with flaggers if a AFAD malfunctions; fails to properly or adequately control traffic; creates congestion, queues or gridlock which cannot be remedied by timely on-site adjustments to the signal operation; or is otherwise inadequate.

A competent flagger, who has been trained on the operation of the AFAD, shall operate and not leave the AFAD(s) unattended at any time. The flagger shall have an unobstructed view of the AFAD(s) and approaching traffic in both directions at all times. The distance between AFADs shall not exceed ½ mile. Work zones utilizing AFADs shall comply with the Standard Sheet for flagger operation on a 2-lane 2-way roadway, where the AFAD is used in lieu of a flagger and a BE PREPARED TO STOP sign (W3-4) is to be used in lieu of the Flagger symbol sign. Red/Yellow lens AFAD shall have a STOP HERE ON RED (R10-6) sign installed on the right-hand shoulder at least 8 ft in advance of the AFAD where vehicles are expected to stop.

A portable traffic signal may be used, at the Contractor's option, as an AFAD. A Signal Ahead symbol (W3-3) sign shall replace the Flagger symbol sign. An 18 inch wide removable stop line with a STOP HERE ON RED (R10-6) sign shall be installed at intended stopping point. The Engineer may waive the requirement for a stop line if the roadway is unpaved or it is otherwise impractical to install a stop line and the STOP HERE ON RED sign is in place.

When the work no longer necessitates use of the AFAD or portable traffic signal, the units shall be removed or turned off and moved out of view from the traveled way.

**M. Maintain Existing Mailboxes.** The Contractor shall not move any mailbox which contains mail. The Contractor will advise the owner to remove mail before the box is moved. Mailboxes shall be mounted, either permanently or temporarily, on a post. Before acceptance of the work, any mailbox which has been disturbed or moved shall be restored by the Contractor at a location consistent with the requirements of the U.S. Postal Service and the contract documents.

**N. Contract Site Patrol.** The Contractor shall provide adequate personnel and supervision to conduct operations and patrol the contract site to ensure that conditions are adequate for public safety and convenience at all times. The Contractor shall patrol the site as often as necessary during working and non-working hours to adjust and maintain signs, channelizing devices, and other traffic control devices and safety features.

**619-3.03 Basic Work Zone Traffic Control (Daily Operations).** The Contractor shall control traffic in accordance with §619-3.02 *Basic Work Zone Traffic Control* paragraphs A. *Surface Condition*; C. *Maintain Public Access*; D. *Maintain Existing Roadside Signs*; F. *Construction Vehicles*; G. *Barrier/Shadow Vehicles*; H. *Construction Signs*; I. *Arrow Panels*; J. *Channelizing Devices*; L. *Flagging*; M. *Maintaining Existing Mailboxes*; and O. *Portable Traffic Signals* so that a person who has no knowledge of conditions may safely and with a minimum of discomfort and inconvenience drive, ride, or walk, during the day or at night, over all or any portion of the highway and/or structure under construction where traffic is to be maintained. The Contractor will not be required to repair or maintain the roadway except to repair any damages resulting from its operations.

The Contractor shall cease operations and clear the traveled way, shoulders, and clear zones of all obstructions including traffic control devices, construction equipment, and materials at the end of each work shift.

**619-3.04 Temporary Business Signs.** The Contractor shall provide temporary business signs (NYI8-4) mounted on temporary sign supports to identify business entrances in accordance with the contract

documents. Entrances shall be identified by only a single sign. Temporary business signs shall be mounted at a minimum height of 7 feet, and at a location that will guide traffic seeking access to the business, but where they will not interfere with traffic flow or other traffic control devices.

**619-3.05 Covering or Removal of Pavement Markings.** The Contractor shall remove or cover existing permanent pavement markings, interim pavement markings and temporary pavement markings, as indicated in the contract documents or directed by the Engineer, to accommodate traffic pattern changes by covering the markings with preformed removable pavement marking masking tape, or by removing the markings. Masking tape shall be placed in blocks to prevent the underlying shape of pavement marking symbols or letters from being confused with existing markings.

**A. Removal of Pavement Markings.** The removal method will be at the Contractor's option, subject to its ability to achieve satisfactory results. Removal shall be completed prior to the installation of temporary pavement markings or interim pavement markings. Grinding to remove pavement markings will typically remove 1/8 to 1/4 inch of pavement surface. Prior to installation, the existing marking and adjacent pavement shall be cleaned of debris by compressed air or sweeping.

**B. Masking Pavement Markings.** Removable pavement marking masking tape shall be installed in accordance with the manufacturer's written instructions. Prior to installation, the existing pavement marking and adjacent pavement shall be cleaned by compressed air, sweeping, or other means adequate to remove debris, but that does not result in damage to the existing pavement marking. The width of the removable pavement marking masking tape shall be sufficient to completely cover the existing pavement marking.

The masking tape shall firmly adhere to the entire length and width of the existing pavement marking to be covered. The Contractor shall maintain the tape for the duration of its use. Any tape that is loosened, removed, or that fails to retain its original matte finish, or that for any other reason fails to obliterate the existing pavement marking shall be replaced immediately, at no additional expense to the State.

When the covered pavement markings are to be restored to service, masking tape shall be removed. Temporary adhesive residues will be allowed to remain, providing that the existing pavement marking visibility is not impaired.

Any damage to the existing pavement markings or to the pavement surface that results from the removal of the masking tape shall be repaired at no additional cost to the State. If the existing marking cannot be repaired satisfactorily, the Contractor shall remove damaged pavement markings completely and/or replace the pavement section at no additional cost to the State.

**619-3.06 Temporary Pavement Markings.** The Contractor shall install and maintain temporary pavement markings in accordance with the contract documents, using patterns and colors shown in the MUTCD to establish temporary traffic pattern(s) during construction on any pavement, including milled or grooved surface, resurfaced, new pavement, or other paved surface without pavement markings, for a maximum of 14 calendar days.

Within 14 calendar days after placement, the Contractor shall either (1) install the succeeding pavement course or (2) install the remaining temporary pavement markings including edge lines, stop bars, and simple crosswalks, with no hatching. Pavements which will be open to traffic shall be properly marked before being opened, before nightfall, or before the end of the work day, whichever is soonest, except areas that are open during the work shift and delineated with channelizing devices or flaggers.

Traffic paint need not be removed before placing a subsequent course. Removable pavement tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall be removed before placing a subsequent course at no additional cost to the State.

Temporary pavement marking stripes shall be a minimum of 4 inches in width. Temporary pavement markings shall be applied to a clean, dry pavement in accordance with the manufacturer's recommendations. Hatch lines and symbols will not be required as temporary pavement markings unless required by the contract documents.

Traffic paint pavement markings shall be applied at a minimum wet film thickness of 20 mil, immediately followed by an application of glass beads, at a rate of 6 lb/gal of paint.

Where specified, removable raised pavement markers shall be used to supplement line pavement markings. The raised markers shall not be a substitute for line pavement markings, letters or symbols. Removable raised pavement markers spaced every 5 feet may be used to supplement line pavement markings. Two removable raised pavement markers spaced at each end of the 2 foot marking may be used to supplement a 2 foot broken line pavement marking.

If unanticipated weather or other conditions prevent the application of temporary pavement markings, the Contractor shall apply 2 foot removable pavement tape markings or temporary overlay markers at 40 foot spaces at no additional cost to the State, for a maximum of 3 days until such time as temporary pavement markings may be applied, or the next pavement course is installed.

**A. Divided Highways.** On freeways, expressways and parkways, the Contractor shall install broken lines a minimum of 2 feet long at 40 foot spacing to separate traffic lanes in the same direction. The Contractor shall install solid edge lines for a minimum of 100 feet on either side of the apex of a gore.

**B. Undivided Multilane Highways.** On three or more lane highways, and two or more lane highways with center two way left turn lanes, the Contractor shall install white broken lines a minimum of 2 feet long at 40 foot spacing to separate traffic flows in the same direction, and partial barrier or full barrier centerline to separate traffic flows in opposite directions.

**C. Two-Lane, Two-Way Highways.** For two-lane, two-way highways, the Contractor shall install a temporary pavement markings consisting of full barrier centerline markings in no passing zones and 2 foot broken line markings at 40 foot spacing in passing zones.

Two-lane, two-way highways may for a maximum of 3 days have the centerline marked with yellow 2 foot by 4 inch removable pavement tape or yellow temporary overlay markers at 40 foot spaces with NO CENTER STRIPE (W8-12) signs and DO NOT PASS (R4-1) signs at no additional cost to the State. A NO CENTER STRIPE sign shall be installed in advance of the area marked with yellow 2 foot removable pavement tape markings or temporary overlay markers, as well as after major intersections and after major traffic generators within the area marked with the removable pavement tape markings or temporary overlay markings. A DO NOT PASS sign shall be installed within 100 feet of the beginning of the area with the removable pavement tape markings or temporary overlay markers, and a second DO NOT PASS sign shall be installed within 1,100 feet of the first DO NOT PASS sign and subsequent DO NOT PASS sign(s) shall not exceed 3,000 feet spacing. On an approach without centerline pavement markings where passing will not be permitted, a black on orange NO PASSING ZONE (W14-3) pennant shaped sign shall be installed on that approach. Full barrier, partial barrier or broken line temporary centerline pavement markings shall be placed within three calendar days.

**619-3.07 Interim Pavement Markings.** Work shall consist of furnishing, applying, and maintaining interim pavement markings as shown in the contract documents or as directed by the Engineer. The work for removable tape, removable wet-night reflective tape, temporary overlay markers and removable raised pavement markers shall include removal. Interim pavement markings are intended for use in diversions, temporary pavement realignments and crossovers, lane shifts and closures, and other traffic patterns associated with construction activities. Interim pavement markings are intended for use for a given phase or season, for a maximum of 1 year.

**A. Installation.** Interim pavement markings shall be applied to a clean, dry pavement in accordance with the manufacturer's recommendations. Interim pavement markings on roadways open to traffic shall be applied in the direction of traffic. Traffic paint and epoxy paint pavement markings shall be applied at a minimum wet film thickness of 20 mils, immediately followed by an application of glass beads at a rate of 6 lb/gal of paint.

Painted markings may be supplemented with removable raised pavement markers. Removable raised pavement markers shall be spaced at 5 feet to supplement a solid line, and 4 markers spaced shall be used to supplement a 10 foot segment of broken line. When used to supplement a solid or broken line, markers shall be spaced a maximum of 80 feet on tangents and a maximum of 40 feet for curves with a radius less than 2,800 feet. Removable raised pavement markers shall not be used alone to simulate interim pavement markings.

**B. Maintenance/Replacement.** Traffic paint or removable tape shall be replaced upon (1) abrasion of the line such that more than 10 percent of the underlying pavement is visible within any 300 feet segment of line or (2) loss of more than 2 consecutive skip lines or (3) loss of more than 50 feet of continuous line or (4) failure of any line to be clearly visible at night under low-beam headlamp illumination when viewed from a distance of 200 feet.

Missing removable raised pavement markers shall be replaced upon (1) loss of more than 10 percent of the markers within a 300 feet long segment of line or (2) loss of more than 3 consecutive markers or (3) failure of any line to be clearly visible at night under low-beam headlamp illumination when viewed from a distance of 200 feet.

The Contractor will not be responsible for damage or loss caused by snowplowing. In the event that such pavement markings are damaged or lost, the Engineer will determine whether to replace the lost pavement markings in kind or with other marking materials. Separate payment will be made for pavement markings replaced, or installed due to damage or loss caused by snowplowing.

**619-3.08 Temporary Rumble Strips.** The Contractor shall install temporary rumble strips in three sets of 6-strip patterns with 10 foot between individual strips. The type of strip installed will be at the Contractor's option, except that sawcut or milled-in strips shall not be installed on new top course surfaces or existing surfaces that will not be paved over. Where there is no usable shoulder, or the shoulder is less than 3 feet wide, the rumble strips should be ended 3 feet short of the edge of usable pavement. On curbed roadways, rumble strips should end a minimum of 3 feet from the curb in order not to interfere with drainage. Rumble strips shall typically be placed in advance of each of the last three long-term advance warning signs such that drivers are alerted in time to see and read the signs. Rumble strips will typically be installed for a minimum of one week.

**A. Raised Asphalt Rumble Strips.** The roadway surface on which the rumble strips are to be attached shall be dry, free of surface contaminants such as dust or oil, and thoroughly swept with a stiff broom. The surface temperature of the pavement shall be 45°F or greater unless otherwise authorized by the Engineer. The pavement surface shall be cleaned with compressed air just prior to tack coating and subsequent installation of the rumble strips. The strips shall be formed using a rumble strip paver (drag box) pulled transversely across the pavement, or by hand placement between forms fixed to the pavement. If forms are used, they shall be removed prior to compaction of the asphalt mixture. Compaction shall be accomplished using a plate tamper or a static roller. Raised asphalt rumble strips shall have a width of 6 to 9 inches, measured in the direction of traffic, and have a final compacted thickness of 3/8 inch ± 1/8 inch.

**B. Raised Removable Tape Rumble Strips.** Raised removable tape rumble strips shall be formed by applying one or more layers of removable preformed pavement marking masking tape. The tape shall be applied to a clean, dry pavement surface in accordance with the manufacturer's recommendations.

The pavement surface shall be swept or cleaned with compressed air just prior to application of the tape.

**C. Raised, Preformed Rumble Strips.** Raised preformed rumble strips shall be applied to a clean, dry pavement surface in accordance with the manufacturer's recommendations. The pavement surface shall be swept or cleaned with compressed air just prior to application of the strip.

**D. Saw-cut Rumble Strips.** Saw-cut rumble strips shall be saw cut into existing pavement using wet cutting methods. The blade or blades shall be of such configuration that the desired dimensions of the saw cut can be made with one pass. No spacers between blades will be allowed.

Before a travel lane with saw-cut rumble strips is reopened to traffic, the pavement shall be cleaned by sweeping, flushing, or with a stream of compressed air. Sawing slurry from the wet-sawing process shall be flushed from the pavement surface immediately.

**E. Milled-in Rumble Strips.** Milled-in rumble strips shall be milled into existing pavement using a rotary-type cutting head with a maximum nominal outside diameter of 24 inches. The cutting head shall be on its own suspension system, independent from that of the power unit, to allow the head to align itself with the slope of the pavement and/or any irregularities in the pavement surface. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with no more than 3/32 inches between peaks and valleys. Prior to beginning work, the Contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the pavement.

Before a travel lane with milled-in rumble strips is reopened to traffic, the pavement shall be cleaned by sweeping, flushing, or with a stream of compressed air.

**F. Removing Temporary Rumble Strips.** The Contractor shall either completely remove raised rumble strips from the pavement or fill in the depressions from saw-cut or milled-in rumble strips prior to the start of the winter plowing season, prior to the placement of successive pavement courses, or as directed by the Engineer. Any damage to the pavement surface resulting from the removal of raised rumble strips shall be repaired at no additional cost to the State.

Rumble strip depressions shall be filled in with hot mix asphalt. Before they are filled, the depressions shall be cleaned by sweeping, flushing, or with a stream of compressed air, and coated with Asphalt Emulsion Tack Coat. The rumble strips shall be overfilled slightly and compacted using a plate tamper or static roller so that the final compacted surface is flush with the existing pavement.

**619-3.09 Interim Tubular Markers.** The Contractor shall install interim tubular markers in accordance with the contract documents. The Contractor shall attach interim tubular markers to the pavement in a manner that prevents them from being moved or dislodged by traffic. Interim tubular markers shall be installed on pavement that has been cleaned to remove pavement markings, oil, dirt, or other debris or substances that may interfere with a proper bond. Attachment to the pavement shall be by mechanical fastener or by adhesive, in accordance with the manufacturer's recommendations. Bonding agents shall be of sufficient amount or size to ensure proper bonding of the base to the pavement.

Interim tubular markers removed or damaged by the Contractor's operations or by traffic shall be replaced immediately, so that positive separation is maintained between opposing lanes of traffic at all times. Damaged reflective sheeting on interim tubular markers shall be replaced before nightfall as necessary to maintain adequate visibility of the markers. In cases where only isolated individual markers are lost or damaged, and adequate visibility is maintained by the remaining markers, replacement will not be required until more than 3 consecutive markers, or 25 percent of all markers within ½ mile have been damaged or lost. The replacement of markers damaged or lost by traffic, where the Contractor has demonstrated reasonable effort to collect the costs from the person(s) responsible for damage will be considered extra work.

**619-3.10 Portable Variable Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS).** The Contractor shall provide, operate and maintain PVMS & TMVMS as indicated in the contract documents until the progress of work no longer requires their use. The Contractor shall relocate or reorient PVMS with a pay unit of each, if necessary, up to 4 times per year as conditions dictate, at no additional cost to the State. The Contractor shall provide, operate and maintain PVMS with a pay unit of weeks at the general locations and duration stated in the contract documents and in accordance with the Special Note *Requirements for Portable Variable Message Signs (PVMS)*. There shall be no extra payment due for each relocation or reorientation of TMVMS. On the PVMS & TMVMS, the message to be displayed shall be as required by the contract documents and may change on a daily basis or more frequently as conditions dictate. NYSDOT's *Variable Message Sign Guidelines* shall be reviewed to ensure compliance with Chapter 5 - *Messages*.

If the contract requires a NTCIP compliant PVMS, the Contractor shall provide the Engineer with the model, manufacture date and manufacturer of the NTCIP compliant PVMS the Contractor plans to use from the Approved List. After delivery to the work site, the Contractor shall allow the Regional Transportation Management Center (TMC) to conduct operations and communications tests on one or more samples supplied by the Contractor. The testing will determine if the proposed PVMS meets the TMC's operational requirements by demonstrating remote communications to and from the TMC using NTCIP compliant operating software. TMVMS do not require NTCIP compliant communications. The message to be displayed shall be as required by the contract documents or as directed by the Engineer.

PVMS specified with cellular communications shall be equipped with control software compatible with the current computer operating system used in the Engineer's Field Office. PVMS with Cellular Communications Option shall have cellular telephone service provided by the Contractor. The Contractor shall supply the Engineer with two copies of operating instructions for the PVMS and the control software. The Contractor shall supply the Engineer with a copy of control software a minimum of 14 calendar days prior to installation of the first unit. Electronic copies of software instructions are acceptable.

PVMS shall be placed so that the base of the message panel is at least 7 feet above the adjacent pavement surface and aligned to provide optimum viewing by approaching motorists. The Contractor shall supply the Engineer with an accurate log of the text of all messages and times messages were displayed monthly, not later than the 15th of the following month. The log of messages may be either a listing in a manual register or printouts from the control software. The Contractor shall inform the Engineer of PVMS and TMVMS locations and update as they are relocated and removed.

The PVMS shall be protected from unauthorized use. All cabinet doors shall be secured and/or padlocked, and default manufacturer's passwords shall be changed. Additional security measures shall be implemented as needed.

**619-3.11 Type III Construction Barricades.** Type III construction barricades shall be installed at all locations where a highway, bridge, ramp, or other segment of the roadway is closed to traffic. Type III construction barricades shall be maintained upright, in proper alignment and orientation. If ballast is used to maintain alignment and position of the barricade, it shall consist of dry sand contained in a closed waterproof bag, and shall be placed at ground level.

Barricade rails shall be oriented such that the stripes slope downward toward the side on which traffic is to pass. If traffic may pass to either side, adjacent barricades shall be arranged such that the stripes slope downward toward each side starting at the center. Where no passage is intended or permitted, the stripes shall slope downward toward the center of the barricade or barricades.

At night, each Type III construction barricade used to close a roadway, a segment of a roadway or a sidewalk shall be equipped with one flashing warning light.

**619-3.12 Temporary Positive Barrier.** Temporary Positive Barriers are categorized by their standard MASH TL-3 (pickup truck) deflection and their deflection reduction measures (pinning and or box-beam-stiffening). The barriers that satisfy a given deflection category are shown on the Department's Approved



List for Temporary Positive Barriers. The system chosen and the segment length used must be capable of meeting the curvatures indicated in the Plans.

The Engineer will inspect temporary barrier segments upon delivery. Any barrier segment having damage and/or defects in the segment and/or joint connections will be rejected if the performance of the barrier may be affected.

Temporary positive barrier segments shall be fastened together to form a continuous string. When joined together, the barrier segments shall form a smooth and continuous barrier. Any segments damaged or misaligned shall be corrected or replaced. The connections shall conform to the approved details for the particular barrier.

Tapered end sections shall not be used in traversable medians, gores, or other areas where impacts on a tapered end section could allow vehicles to penetrate opposing or adjacent lanes of traffic. Where the posted speed limit is 45 mph or higher, a temporary impact attenuator or temporary sand barrel array shall be provided on approach ends of temporary positive barrier when the offset from the edge of the traveled way to end of the barrier is less than 12 feet and will be paid for separately.

Where space is available, approach ends of the barrier string shall be flared away from the traveled way at the taper rate shown in Table 619-5 *Flare Rates for Positive Barrier* and terminated in a tapered end section, embedded in a slope, or otherwise protected against impact by errant vehicles.

The Contractor shall install temporary barrier where indicated, and of the deflection Category indicated in the contract documents. Where pinning is indicated for the given barrier, the pinning shall be in conformance with the pinning requirements indicated in the Approved List. Where pins extend above the top surface of the barrier anchor recess, they shall be covered with plastic or rubber.

<b>TABLE 619-5 FLARE RATES FOR TEMPORARY POSITIVE BARRIER</b>					
<b>POSTED PRECONSTRUCTION SPEED LIMIT (mph)</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>55</b>	<b>65</b>
<b>TEMPORARY POSITIVE BARRIER</b>	8:1	11:1	14:1	16:1	20:1
<b>BOX BEAM OR HEAVY POST CORRUGATED BEAM</b>	7:1	9:1	11:1	12:1	15:1

<b>TABLE 619-6 GUIDE RAIL AND NYSDOT TEMPORARY CONCRETE BARRIER STANDARD** DEFLECTION DISTANCES</b>		
<b>BARRIER TYPE</b>	<b>POST SPACING (ft)</b>	<b>DEFLECTION DISTANCE (ft)</b>
<b>CABLE GUIDE RAIL</b>	16	11.0*
	12	9.5*
	8	8.0*
	4	7.0*
<b>CORRUGATED W-BEAM (WEAK POST) GUIDE RAIL</b>	12.5	8.0
	6.25	6.0
	4.16	5.0
<b>CORRUGATED W-BEAM (HEAVY POST BLOCKED OUT)</b>	6.25	4.0
	3.12	2.0
<b>BOX BEAM GUIDE RAIL</b>	6.0	5.0
	3.0	4.0
<b>CORRUGATED W-BEAM (WEAK POST) MEDIAN BARRIER</b>	12.5	7.0
	6.25	5.0
<b>CORRUGATED W-BEAM (HEAVY POST)</b>	6.25	2.0

<b>MEDIAN BARRIER</b>		
<b>BOX BEAM MEDIAN BARRIER</b>	6.0	3.0
<b>NYSDOT TEMPORARY CONCRETE BARRIER</b>	Unpinned	3.25**
	Box-Beam-Stiffened	2.2**
	Pinned	0.8**

\* Note: NCHRP 350 Standard Deflection caused by a 4,400-lb test vehicle traveling 62 mph impacting the barrier at a 25° angle

\*\*Note: Standard Deflections are those assumed to occur with a Standard TL-3 Impact. MASH Standard Impact is produced by a 5,000-lb test pickup traveling 62 mph impacting the barrier at a 25° angle.

The temporary concrete barrier stiffened with box beam shall be installed at least 50 feet prior to, be continuous through, and extend at least 50 feet beyond the area requiring limited deflection, wherever practicable. Where space limits extending the string of barrier stiffened with box beam, one segment at either end of the string shall be pinned with 4 pins on the construction, or non-traffic, side.

At any transition between pinned and unpinned portions of a temporary positive barrier run, to provide a gradual change in fixity, one piece of barrier shall be partially pinned using 2 pins on the construction side of the barrier. The partially pinned piece shall be included in the measurement of pinned barrier.

Pins shall have the following minimum embedment lengths:

- Bridge Decks and Cement Concrete Pavement 5 in.
- Flexible Pavement 18 in.
- Unpaved Areas 30 in.

After removal of the barrier, pin holes created in the surface shall be filled, unless that area will be further disturbed. Holes in flexible pavement shall be filled with warm or cold mix top course asphalt material rodded in 3" lifts. Holes in portland cement concrete pavement or structural decks shall be filled with material meeting the requirements of §701-05 *Concrete Grout Material* or §721-03 *Epoxy Polysulfide Grout*. Holes in unpaved area shall be filled with sand backfill.

**A. Temporary Barrier Without Warning Lights.** Where warning lights for temporary positive barrier are not required, the Contractor shall provide and maintain delineation on the temporary barrier in accordance with Section 619-2.12. The delineation shall be visible and free of dirt and snow, including during shutdown periods. The maximum spacing of delineation shall be 20 feet.

**B. Temporary Barrier With Warning Lights.** Where warning lights are specified, Type C warning lights shall be provided on temporary barrier. The maximum spacing of warning lights shall be 40 feet in tangents and 20 feet in curves with radii less than 2,800 feet. Warning lights shall be attached to the barrier so that the lights remain securely in place and so that the attachment minimizes damage to the barrier.

All warning lights shall be kept clean, properly aligned, and in operating condition. Batteries shall be replaced as necessary.

Where channelizing devices with Type A flashing warning lights are not provided immediately preceding a run of barrier to be marked with warning lights, the first warning light on that run of barrier shall be a Type A warning light.

**C. Box Beam Guide Rail to Temporary Positive Barrier (Concrete) Transition.** Where required, the Contractor shall install the Transition from Box Beam to Flared Temporary Concrete Barrier or the

Transition from Box Beam to Unflared Temporary Concrete Barrier in accordance with the details shown on the Standard Sheets. With the approval of the Engineer, the Contractor may choose to switch options, at no additional cost to the State.

Where the Contractor elects or is required to bolt the box beam to the face of the Temporary Concrete Barrier, the pieces of box beam thus bolted shall be removed and become the Contractor's property when the Temporary Concrete Barrier is removed. After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts and new or acceptable reset box beam guide rail.

When an unflared Box to Temporary Concrete Barrier transition is removed, the heavy posts, blockouts, rub rail, and Transition End Piece and associated hardware shall become the property of the Contractor and shall be removed from the project before its completion.

***D. Temporary Positive Barrier (Concrete) to Box Beam Guide Rail Transition.*** Where required, the Contractor shall install "Temporary Concrete Barrier Face to Box Beam Transition" or "Temporary Concrete Barrier Back to Box Beam Transition" in accordance with the details shown on the Standard Sheets. When the box beam is mounted to the traffic-side face, a tapered box beam end piece shall be used. When the box beam is behind the Temporary Concrete Barrier, the Contractor shall bolt to the Temporary Concrete Barrier or shall provide an overlap of box beam extending upstream past four segments of the downstream end of the Temporary Concrete Barrier.

When box beam is required to be bolted to the Temporary Concrete Barrier, or the Contractor elects to do so, the necessary positions for the bolts shall be located on the Temporary Concrete Barrier and drilled in the field. The pieces of box beam thus bolted shall be removed and become the Contractor's property when the Temporary Concrete Barrier is removed. After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts and new or acceptable reset box beam guide rail.

***E. Corrugated Beam Guide Rail to Temporary Positive Barrier (Concrete) Transition.*** Where required, the Contractor shall install the W-Beam to Flared TCB Transition (Leading End) in accordance with the details shown on the Standard Sheets.

After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts, new or acceptable reset corrugated guide rail, new hardware, and new blockouts, backup plates, or other hardware required to meet current standards. Any terminal rail pieces, posts, or other guide rail components not required for the restored guide rail shall become the property of the Contractor and shall be removed from the project before its completion.

***F. Temporary Positive Barrier (Concrete) to Corrugated Beam Guide Rail Transition.*** Where required, the Contractor shall install "Temporary Concrete Barrier Face to Corrugate Beam Transition" or "Temporary Concrete Barrier Back to Corrugated Beam Transition" in accordance with the details shown on the Standard Sheets. When the corrugated beam is mounted to the traffic-side face, a W-beam end piece shall be used. When the corrugated beam is behind the Temporary Concrete Barrier, the Contractor shall bolt to the Temporary Concrete Barrier as shown on the Standard Sheets or shall provide an overlap of corrugated beam extending upstream past four segments of the downstream end of the Temporary Concrete Barrier.

When corrugated beam is required to be bolted to the Temporary Concrete Barrier, or the Contractor elects to do so, the necessary positions for the bolts shall be located on the Temporary Concrete Barrier and drilled in the field. The terminal rail pieces or W-Beam End Pieces thus bolted shall be removed and become the Contractor's property when the Temporary Concrete Barrier is removed. After removal of the Temporary Concrete Barrier, any rail and posts removed to facilitate

placement of the Temporary Concrete Barrier transition shall be promptly replaced with new posts and new or acceptable reset corrugated beam guide rail.

**619-3.13 Temporary Glare Screen.** Temporary glare screen shall be installed in accordance with the manufacturer's instructions. All components of the glare screen shall be maintained in a safe and functional condition. Damaged components shall be repaired or replaced.

If blades are utilized, the blades shall be spaced and angled to provide approximately a 22E headlight cutoff angle. The screen shall not overhang the face of the barrier and shall not cover delineation or lights. The screen shall be kept plumb and properly positioned on the barrier, with reflectorization securely affixed to the screen. Cleaning of the reflectorization shall be by a method that does not damage the paddles, reflectorization or barrier, and is not hazardous to traffic.

The Contractor shall remove and dispose of the temporary glare screen upon completion of the contract or when it is no longer required. Upon removal of the temporary glare screen, there shall be no protrusions remaining on the top face of the barrier. Bolt holes or other damage to permanent barrier from glare screen installation shall be repaired by the Contractor at no additional cost to the State.

**619-3.14 Temporary Impact Attenuator.** The Contractor shall install temporary impact attenuators in accordance with the contract documents, the manufacturer's instructions and materials details. The Contractor shall provide the Engineer a copy of the manufacturer's materials details and installation instructions a minimum of 7 calendar days prior to use, to allow verification of the attenuator supplied and proper installation. The selection of the manufacturer and model of temporary impact attenuator shall be at the Contractor's option, provided the attenuator supplied is of the type indicated, gating or redirective; shields the hazard; and fits in the location without encroachment into travel lanes or required offsets.

The Contractor shall maintain temporary impact attenuators for continuous operation. If an attenuator is out of operation, the Contractor shall immediately mark the hazard with drums, vertical panels and or extra tall cones until repairs are made or a new attenuator is installed. The Contractor shall promptly begin repairs to damaged attenuators, and shall complete repairs to a damaged attenuator or mitigate the hazard within 1 work day. Attenuators damaged beyond repair shall be replaced within 3 work days.

When temporary impact attenuators are removed or moved to another location, the Contractor shall restore the location to match the surrounding area.

**619-3.15 Temporary Sand Barrel Arrays.** The Contractor shall install sand barrel arrays in accordance with the patterns shown on the Standard Sheet or a NCHRP 350 approved pattern and fill the barrels with sand to provide the desired module weight, plus or minus 5 percent. Units that will be in use between November 1 and March 31 shall have sodium chloride, as dry rock salt, equal to 3% - 5% by weight of the sand, thoroughly mixed into the sand to prevent freezing. The sand shall be placed in the modules loose, not in bags or sacks. If the contract documents indicate that the site necessitates securing of the modules, the work shall be performed as recommended by the manufacturer.

The Contractor shall maintain sand barrel arrays for continuous 24 hour operation. If an array is out of operation, the Contractor shall immediately mark the hazard with drums, vertical panels and or extra tall cones until repairs are made or new module(s) are installed. The Contractor shall promptly begin repairs to damaged arrays, and shall complete repairs to a damaged array or mitigate the hazard within one work day.

**619-3.16 Vehicle Arresting Barrier (VAB).** Vehicle arresting barriers (VAB) shall be installed in accordance with the contract documents and the manufacturer's instructions and materials details. The Contractor shall provide the Engineer a copy of the manufacturer's materials details and installation instructions a minimum of 5 work days prior to use, to allow verification of the barrier supplied and proper installation. The deceleration area behind the VAB shall be kept clear of workers, vehicles or

stored materials. The Contractor shall provide for periodic surveillance of each VAB by workers or by electronic device.

The Contractor shall maintain vehicle arresting barrier for continuous operation. If a barrier is out of operation, the entire barrier shall be restored within 4 hours after the incident, or prior to the next shift the barrier will be used. No work may be progressed in an unprotected area, and the hazard shall be eliminated or minimized, until restorations have been completed.

The VAB, except anchorages, shall be dismantled and removed prior to reopening the road to traffic. After the last day of use, if directed by the Engineer, temporary anchorages shall be removed and disturbed areas shall be restored to match the surrounding area.

**619-3.17 Maintain or Modify Traffic Signal Equipment.** Traffic signals shall be maintained in proper operation, including the maintenance of all features of the traffic signal operation in effect and operating at the time any work begins on the contract. Traffic-actuated phases shall remain actuated, and signals operating within signal systems shall remain coordinated with the remainder of the system unless otherwise approved by the Engineer. Except for emergencies, no changes in the signal operation or timing shall be made without prior approval by the Engineer. If emergency conditions dictate a change in the operation, the Engineer shall be notified by the start of the next work day. Unless otherwise approved by the Engineer, an altered signal operation must be returned to the original signal operation within 24 hours.

The Contractor shall maintain in operation all equipment including signal heads, supports, cable, wiring, span-wire-mounted signing, controllers, master controllers, detector systems, conflict and current monitors, relays, switch packs, and all other accessory and necessary equipment. Maintenance shall also include the repair and replacement of existing detector loops, paid for separately.

The Contractor shall have capable traffic signal repair personnel on call 24 hours a day, seven days a week, and shall provide to the Engineer a single telephone number for contacting them. If for any reason a signal is not functioning properly, the Contractor shall commence work on the signal within 2 hours of notification. If directed by the Engineer, the Contractor shall notify the appropriate police agency for traffic control operations. If the police agency cannot or will not provide traffic control, the Contractor shall provide flaggers at locations specified by the Engineer within the 2-hour time period. The Contractor shall continue the flagger services until the signal is in proper operation. A flagger warning (W20-7 or W20-7a) sign shall be used on all approaches to an intersection controlled by flaggers.

If the malfunction is in the equipment supplied by the State, due to an area wide power outage, or due to a localized power outage beyond the Contractor's control, the Contractor shall notify the Engineer and, if directed by the Engineer, provide flaggers until the malfunction is corrected or State personnel take over. Such flagging operations in excess of 4 hours for the first call and for any subsequent call will be considered extra work.

The Contractor shall provide the Engineer, on a monthly basis, with a record of all maintenance calls received and responded to, as well as a record of all corrective action taken by the Contractor.

**A. Requirement A.** The Contractor shall maintain in proper operation the indicated existing, relocated, modified, and newly installed signals in accordance with the contract documents. If such signals are to be removed, the Contractor shall be responsible for operation and maintenance until the signals are removed. The Contractor shall be responsible for their continuous operation except for reasonable shutdown periods authorized by the Engineer during relocation and transfer operations.

**B. Requirement B.** The State shall assume operation and maintenance responsibility for the signal from the Contractor following successful completion by the Contractor of the installation /modification testing as required by Section 680 *Traffic Signals*. The six month warranty/guarantee period shall be measured from the day the State assumes maintenance responsibility.

**C. Requirement C.** At relocated, modified or newly installed signals, the Department will assume responsibility for the following items after successful testing as required by Section 680 *Traffic*

*Signals* has been completed. Assumption of the below listed responsibilities by the State will not relieve the Contractor of the responsibility for operation and maintenance of the signal. At existing microcomputer controlled traffic signals, the Department will be responsible for the following items:

1. Supply and maintenance of the microcomputer assembly and software.
2. Programming of the microcomputer furnished by the State.
3. Operation or timing changes directed by the Engineer.
4. Normal (no abuse or vandalism) equipment failures of existing, relocated, modified or new traffic signal equipment furnished by the State.

**D. Modify Traffic Signal Equipment.** Where the Contractor is required to temporarily modify or relocate existing traffic signals because of construction operations, all existing equipment, fittings, wire, cable, conduit, and related materials shall be reinstalled and extended where necessary. Temporary timber poles, guys, and related material shall be furnished and installed where necessary.

**619-3.18 Temporary Traffic Signals.** The Contractor shall install temporary traffic signals in accordance with the contract documents and the MUTCD. The Contractor shall maintain traffic signal systems, including traffic detectors, in proper operation until approved removal, and be responsible for its continuous 24-hour operation except for reasonable shutdown during relocation and transfer operations. Substitution of temporary traffic signals for flaggers shall be at no additional cost to the State.

If for any reason a signal does not function as required, the Contractor shall commence repair work on this signal within 2 hours after notification of a malfunction. In the event flashing operation occurs, all signal faces shall show flashing red indications. Flashing operation of a signal is considered a malfunction. The Contractor shall provide an adequate number of flaggers to control traffic at each malfunctioning traffic signal, in accordance with '619-3.02L. *Flagging and Traffic Control* until the signal is restored to proper operation.

If the malfunction is due to an area wide power outage or due to a localized power outage beyond the Contractor's control, the Contractor shall notify the Engineer and, if directed by the Engineer, provide flaggers until the malfunction is corrected or State personnel take over. Flagging operations in excess of 4 hours for the first maintenance call shall be paid for as extra work.

**619-3.19 Nighttime Operations.** Work occurring after sunset and before sunrise will be considered nighttime operations. All workers involved in nighttime operations shall wear protective helmets and nighttime apparel in accordance with §107-05A. *High Visibility Apparel* at all times.

Vehicles operating on the pavement of a closed roadway or travel lane shall display four-way flashers or rotating amber beacons at all times. Vehicles using headlights, except for rollers and vehicles retrieving channelizing devices, shall travel facing in the same direction as adjacent traffic in order to avoid glare and confusion to drivers.

The Contractor shall meet the following additional requirements for work zone traffic control during nighttime operations.

**A. Nighttime Operations and Lighting Plan.** Thirty days prior to the start of nighttime operations, the Contractor shall submit a written Nighttime Operations and Lighting Plan to the Engineer for approval. The plan shall detail all aspects of the traffic control setup, the functions, responsibilities and identities of the nighttime traffic control competent person and other details as necessary. It shall include a contingency plan identifying foreseeable problems and emergencies that may arise, and the approach that will be used to address them. This plan shall be revised and updated by the Contractor as necessary during the progress of the work to accommodate conditions on the contract.

The Contractor shall submit a Nighttime Operations and Lighting Plan to the Engineer, at a scale and printed size similar to the contract plans and appropriate to adequately describe the work, including the following:

- Layout showing location of light towers, including typical spacing, lateral placement and mounting height, and clearly show the location of all lights necessary for all work to be done at night.
- Description of light towers to be used and electrical power source.
- Specific technical details on all lighting equipment, including brand names, model numbers, power rating and photometric data.
- Details of any hoods, louvers, shields or other means to be used to control glare.
- Attachment and mounting details for lights to be attached to equipment.
- Lighting calculations confirming that the illumination requirements will be met by the layout.

The Contractor shall maintain a supply of emergency flares for use in the event of unanticipated situations such as traffic accidents, equipment breakdowns, failure of lighting equipment, etc.

**B. Lighting for Nighttime Operations.** Prior to the first night of nighttime operations, the Contractor shall set up and operate the lighting equipment at night as a trial run to demonstrate its ability to establish a safe, properly illuminated, nighttime operation. The Contractor shall furnish the Engineer with a photometer, capable of measuring the level of illumination, for use as necessary to check the adequacy of illumination throughout nighttime operations.

**1. Equipment.** The Contractor shall supply all lighting equipment required to provide a work zone safe for the workers and traffic. Material and/or equipment shall be in good operating condition and in compliance with applicable safety and design codes.

*a. Light Towers.* Light towers shall be provided as a primary means of illumination, and shall provide Level I illumination throughout the work space. They may be supplemented to the extent necessary by lighting fixtures mounted on construction equipment to provide Level II or Level III illumination where required for paving, milling and similar moving operations. Light towers shall be sturdy and free-standing without the aid of guy wires or bracing, and shall be capable of being moved as necessary to keep pace with construction operations. Light towers shall be positioned to minimize the risk of being impacted by traffic on the roadway or by construction traffic or equipment.

*b. Light Towers on Paving, Milling, and Finishing Machines.* If needed to supplement portable and/or trailer-mounted light towers, towers shall be affixed to paving, milling, and finishing machines to provide the required level of illumination for the specified distance in front of and behind the machine. Luminaires shall be aimed and adjusted to provide uniform illumination with a maximum uniformity ratio of 5:1. The hopper, auger, and screed areas of pavers and the operator's controls on all machines shall be uniformly illuminated.

*c. Construction Equipment Lights.* All construction equipment, including rollers, backhoes, loaders, and other equipment operating in areas not illuminated to a minimum of Level I Illumination, shall be equipped with a minimum of two 500 watt flood lights facing in each direction to provide a minimum of 1 foot-candle of horizontal illumination measured 60 feet in front of and behind the equipment. In areas illuminated to a minimum of Level I, construction equipment may move unescorted. In non-illuminated areas, construction equipment shall be equipped with conventional vehicle headlights, shall be illuminated with flood lights on the vehicle, or shall be escorted to permit safe movement. Headlights shall not be permitted as the sole means of illumination while working.

*d. Equipment Mounting.* The Contractor shall provide suitable brackets and hardware to mount lighting fixtures and generators on machines and equipment. Mountings shall be designed so that light fixtures can be aimed and positioned as necessary to reduce glare and to provide the required illumination. Mounting brackets and fixtures shall not interfere with the equipment operator or any overhead structures, and shall provide for secure connection of the fixtures with minimum vibration.

*e. Portable Generators.* The Contractor shall provide portable generators to furnish adequate power to operate all required lighting equipment. Fuel tank capacity and availability of fuel on site shall be sufficient to permit uninterrupted operation throughout the planned shift. Adequate switches shall be provided to control the various lights. All wiring shall be weatherproof and installed in accordance with 29 CFR 1926 Subpart K. All power sources shall be equipped with a Ground-Fault Circuit Interrupter.

**2. Illumination Requirements.** Tower-mounted luminaires, whether fixed, portable, trailer-mounted, or equipment-mounted, shall be of sufficient wattage and/or quantity to provide the required level of illumination and uniformity over the area of operation while minimizing glare.

The uniformity of illumination, defined as the ratio of the average illumination to the minimum illumination over an area requiring an indicated illumination level, shall not exceed 5:1. Illumination levels on approach roadways should be increased sequentially to prevent motorists from becoming disoriented by rapid changes from full dark to very bright conditions.

Existing street and highway lighting shall not eliminate the need for the Contractor to provide lighting. Consideration will be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided. Such consideration shall be presented in the Contractor's lighting plan. In the event of any failure of the lighting system, nighttime operation(s) shall be discontinued until the required level of illumination is restored.

*a. Level I (5 foot-candles).* Level I illumination shall be provided for all areas of general construction operations to include all work operations by Contractors personnel, including work zone traffic control set-up and operations, staging, excavation, cleaning and sweeping, pavement marking, spoil disposal, landscaping, planting and seeding, layout and measurements ahead of the actual work, borrow areas, spoil areas, and truck cleanout areas. Level I illumination shall be provided near the beginning of lane closure tapers and at road closures for nighttime work zones, including the setup and removal of the closure tapers. Level I illumination shall be provided a minimum of 400 feet ahead and 800 feet behind a paving or milling machine, or for the entire area of concrete placement or pavement work if less than this distance. This area shall be extended as necessary to incorporate all vehicle and equipment operations associated with the paving operation.

The only exception to the requirement for Level I illumination throughout the area of construction operations is that finish rollers can work beyond the area of Level I illumination using floodlights mounted on the roller.

*b. Level II (10 foot-candles).* Level II illumination shall be provided for flagging stations, asphalt paving, milling, and concrete placement and/or removal operations, including bridge decks, 50 feet ahead of and 100 feet behind a paving or milling machine.

*c. Level III (20 foot-candles).* Level III illumination shall be provided for pavement or structural crack filling, joint repair, pavement patching and repairs, installation of signal equipment or other electrical/mechanical equipment, and other tasks involving fine details or intricate parts and equipment.



**3. Glare Control.** All lighting shall be designed, installed, and operated to avoid glare that affects traffic on the roadway or that causes annoyance or discomfort for residences adjoining the roadway. The Contractor shall locate and aim lighting fixtures to provide the required level of illumination and uniformity in the work zone without the creation of objectionable glare. The Engineer will determine when glare exceeds acceptable levels, either for traffic or for adjoining residences.

The Contractor shall provide shields, visors or louvers on luminaires as necessary to reduce objectionable levels of glare. As a minimum, the following requirements shall be met to avoid objectionable glare on roadways open to traffic in either direction:

- Tower-mounted luminaires shall be aimed either generally parallel or perpendicular to the roadway.
- Luminaires shall be aimed such that the angle between the center of the beam axis and the vertical mounting pole is no greater than 45°.
- No luminaires shall be permitted that provide a luminous intensity greater than 20,000 candelas at an angle of 72° above the vertical.
- Except where prevented by overhead utilities or structures, towers shall be extended to their full working height when in use to reduce glare and provide uniform illumination.

**619-3.20 Traffic Control Supervisor.** When indicated in the contract documents, the Contractor shall provide a dedicated traffic control supervisor having adequate training, experience, and authority to implement and maintain all traffic control operations. The traffic control supervisor shall not be assigned other duties that interfere with performance as a traffic control supervisor.

The traffic control supervisor shall be adequately trained in traffic control operations by recognized training programs, including the American Traffic Safety Services Association “Traffic Control Supervisor”, the National Safety Council, unions, or construction industry associations, or by an individual instructor from such a program. Traffic control supervisors not competent to the satisfaction of the Engineer shall be replaced immediately.

During setup and removal of lane closures and other traffic control setups, the traffic control supervisor shall be assisted by additional workers as necessary. The traffic control supervisor shall patrol the contract area to ensure that conditions on the site are adequate for public safety and convenience at all times, to monitor worker safety from intrusions into the work area, and to ensure that the work adheres to the provisions for work zone traffic control. The traffic control supervisor shall ensure signs, channelizing devices, barricades, barrier, impact attenuators and other traffic control devices are adjusted and maintained as necessary. The Contractor shall provide workers to install, maintain, adjust, and remove traffic control devices as required by the work operations.

When the work does not require closure of an active lane, roadway, or ramp; when no construction operations occur within 30 feet of active traffic lanes; and when there is no delivery of materials or equipment; the Engineer may waive the requirements for a traffic control supervisor.

**619-3.21 Temporary Structures and Approaches.** The Contractor shall design, construct, maintain, relocate, and remove temporary structures and their approaches at the location(s) shown in and in accordance with the contract documents. The Contractor shall install temporary structures and their approaches, including any required earth support structures and any necessary appurtenances, in a manner and sequence that interference with and inconvenience to the traveling public and abutting properties is kept to a minimum. The Contractor shall be responsible for the workmanship, upkeep, and safety of all temporary structures and approaches.

When specific details are not included in the contract documents, or when the Contractor receives approval to deviate from the contract documents, the Contractor shall design all elements of the temporary structure and approaches including the railing system, on the structure and its approaches.

The design of temporary structures and their approaches shall be in conformance with the *NYS DOT Load and Resistance Factor Design (LRFD) Bridge Design Specifications*, the only design live load shall be HL-93, in addition to any anticipated construction or pedestrian loading. Alternatively, the design shall be in conformance with the *NYS DOT Standard Specifications for Highway Bridges*, the minimum design live load shall be AASHTO HS 20. Exception, any structure and approaches that are expected to be in service for more than 5 years, shall be designed as a permanent structure in accordance with the *NYS DOT Load and Resistance Factor Design (LRFD) Bridge Design Specifications*.

The bridge rail shall be designed for loads commensurate with those specified for TL-2 unless a higher level is shown in the project plans. The Contractor shall also be responsible for designing, furnishing and installing the transition from bridge rail to highway rail for the temporary structure.

All design computations and associated working drawings shall bear the stamp and signature of a Professional Engineer and shall be submitted to the DCES for review. Design for non-highway temporary bridges shall be in accordance with AASHTO specifications for the design codes, loading, railing/barrier, ADA requirements and vertical clearance it is intended to serve or as specified in the project plans.

All fabrication and construction of a temporary structure shall conform to the *AASHTO Standard Specifications for Highway Bridges, Division II* or the *AASHTO LRFD Bridge Construction Specifications*, except as modified herein. Fabrication shall be performed by a fabricator that is certified by AISC for the type of work being performed. For fracture-critical member (FCM) work, the fabricator shall also have an FCM endorsement through AISC. The Contractor shall notify the DCES of the fabrication schedule at least 21 calendar days prior to commencement of any non-pre-engineered proprietary shop fabrication.

All welding required for the fabrication of temporary steel structures shall be performed in accordance with the provisions of the NYS Steel Construction Manual.

The Contractor is responsible for furnishing and installing any stone fill slope protection in accordance with Section 620 used to guard against erosion and/or scour of the end slopes and all temporary substructures. The type of the fill slope protection shall be as shown in the contract plans and paid under Item 619.05nn.

If the bridge connects sidewalk at each end of the bridge, payment for all approach sidewalk and earthwork necessary to connect the temporary structure with the existing sidewalk system shall be as shown in the contract plans and paid under Item 619.05nn.

Load rating calculations for the temporary structure shall bear the stamp and signature of a professional Engineer and shall be submitted to the DCES for review. Load ratings shall be computed using the Load Factor Design (LFD) or Allowable Stress Design (ASD) methodology. The Inventory and Operation load ratings shall be based on an AASHTO HS-20 live loading. Additionally, if the structure was designed using the *NYS DOT LRFD Bridge Design Specifications*, the load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. LRFR ratings shall be provided at the Inventory and Operating levels as rating factors of the AASHTO HL-93 live load. All Load Ratings shall be calculated in accordance with AASHTO's *The Manual for Bridge Evaluation*.

Prior to beginning construction of any temporary structure designed by the Contractor, the Contractor shall submit detailed plans and calculations to the DCES for review and approval in accordance with §585-3.03 *Working Drawings*. The review by the DCES, does not and shall not relieve the Contractor of the responsibility for the adequacy and design of the temporary structures and approaches.

Prior to opening a temporary structure to traffic, the structure shall be inspected by a Professional Engineer who shall certify in writing to the Engineer that the structure was constructed in accordance with the design.

The Contractor shall have the temporary structure inspected, under the direction of a Professional Engineer, by a person familiar with bridge construction at least once a month.

On or before each anniversary of the opening of a temporary structure that has been open to traffic for one year or more, the structure shall be inspected by a Professional Engineer, who shall certify in writing that:

1. The plans of the structure, including its foundations, have been reviewed.
2. A hands-on inspection of the structure has been performed in accordance with the latest edition of the NYSDOT Bridge Inspection Manual by an inspection team whose leader is a Professional Engineer that meets qualifications of a Team Leader as described in the NYSDOT Bridge Inspection Manual.
3. A detailed inspection of those areas of the structure critical to its integrity has been performed.
4. The structure is currently adequate for its design loads.

A signed and stamped copy of the inspection results shall be provided to the Engineer within one week of the inspection.

**619-3.22 Pavement Patching.** The Contractor shall place paving materials suitable to provide temporary pavement patches on paved surfaces where vehicular, bicycle or pedestrian traffic is to be maintained, including the traveled way, shoulders, sidewalks, and other paved surfaces damaged by traffic or environmental factors and not by Contractor operations. During periods of active work on the contract, the Contractor shall complete needed patches on a daily basis. During periods of winter shutdown, the Engineer will inspect the pavement on frequent and regular intervals and will notify the Contractor of areas to be patched. The Contractor shall install pavement patching, at locations identified by the Engineer, within 24 hours of notification.

The Contractor shall place pavement patches to provide a relatively smooth, uniform driving surface suitable for safe travel at the posted speed limit. Pavement patches shall be placed to repair surface irregularities including, but not limited to, holes, depressions, cracks and uneven joints. Areas to be patched shall be adequately cleaned and tack-coated if necessary, and patching material shall be thoroughly compacted by hand or by roller.

**619-3.23 Mailboxes.** In the event the original mounting post has been lost, damaged, is unusable, or is not consistent with U.S. Postal Service requirements, the Contractor shall furnish and install a new mounting post and/or mailbox with mounting post at the designated location and at the proper height in accordance with the requirements of the U.S. Postal Service.

**619-4 METHOD OF MEASUREMENT**

**619-4.01 General.** (None Specified.)

**619-4.02 Basic Work Zone Traffic Control.** The work under basic work zone traffic control will be measured for payment on a lump sum basis.

**619-4.03 Basic Work Zone Traffic Control (Daily Operations).** The work under basic work zone traffic control (daily operations) will be measured for payment on a lump sum basis.

**619-4.04 Temporary Business Signs.** The quantity to be measured for payment will be in square feet to the nearest 0.1 square feet of business signs installed.

**619-4.05 Covering or Removal of Pavement Markings.** The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes covered or removed. No measurement will be made for the gaps between broken and dotted line segments. If preformed tape is used to cover an existing line, payment will be based on the width of the line covered. Measurement for covering or removal of striping with a width greater than 4 inches will be made by the following method:

$$\frac{\text{Width of Striping (in)} \times \text{Number of Feet}}{4 \text{ (in)}}$$

Letters and symbols will be measured by each unit covered or removed. A unit will consist of one letter or one symbol except that a double-headed arrow will be measured as two units and triple headed arrow will be measured as three units. Example: "SCHOOL" would be measured as six units. Each R in a railroad crossing marking will be measured as a single unit, but the "X" will be measured by the number of feet of 4 inch stripe.

**619-4.06 Temporary Pavement Markings.** The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes installed, and will be based on a 4 inch wide stripe. No measurement will be made for the length of skips in the dashed line. Measurement for installation of striping with a width greater than 4 inches will be made by the following method:

$$\frac{\text{Width of Striping (in)} \times \text{Number of Feet}}{4 \text{ (in)}}$$

**619-4.07 Interim Pavement Markings.** The quantity to be measured for payment will be in feet to the nearest whole foot along the centerline of the pavement stripes installed, and will be based on a 4 inch wide stripe. No measurement will be made for the length of skips in the dashed line. Measurement for installation of striping with a width greater than 4 inches will be made by the following method:

$$\frac{\text{Width of Striping (in)} \times \text{Number of Feet}}{4 \text{ (in)}}$$

Letters and symbols will be measured by each unit installed. A unit will consist of one letter or one symbol except that a double-headed arrow will be measured as two units and triple headed arrow will be measured as three units. Example: "SCHOOL" would be measured as six units. Each R in a railroad crossing marking will be measured as a single unit, but the "X" will be measured by the number of feet of 4 inch stripe.

**619-4.08 Temporary Rumble Strips.** The quantity to be measured for payment will be in feet to the nearest whole foot of individual temporary rumble strip installed, measured transverse to the direction of traffic flow.

**619-4.09 Interim Tubular Markers.** The quantity to be measured for payment will be the number of interim tubular markers installed.

**619-4.10 Portable Variable-Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS).** The quantity of PVMS or TMVMS with a pay unit of each to be measured for payment will be the number of signs provided. The quantity of PVMS or TMVMS with a pay unit of weeks to be measured for payment will be in weeks to the nearest whole week.

**619-4.11 Type III Construction Barricades.** The quantity to be measured for payment will be the number of barricade units installed.

**619-4.12 Temporary Positive Barrier.** The quantity to be measured for payment of temporary positive barrier will be in feet to the nearest foot along the centerline of temporary positive barrier installed.

The quantity to be measured for payment of Box Beam to Flared Temporary Concrete Barrier Transition will be the number of such transitions installed.

The quantity to be measured for payment of Box Beam to Unflared Temporary Concrete Barrier Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Face to Box Beam Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Back to Box Beam Transition will be the number of such transitions installed.

The quantity to be measured for payment of Corrugated Beam to Flared Temporary Concrete Barrier Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Face to Corrugated Beam Transition will be the number of such transitions installed.

The quantity to be measured for payment of Temporary Concrete Barrier Back to Corrugated Beam Transition will be the number of such transitions installed.

**619-4.13 Temporary Glare Screen.** The quantity to be measured for payment will be in feet to the nearest whole foot along the length of the temporary glare screen installed.

**619-4.14 Temporary Impact Attenuator.** The quantity to be measured for payment will be the number of temporary impact attenuators installed.

**619-4.15 Temporary Sand Barrel Arrays.** The quantity to be measured for payment will be the number of individual sand barrel modules installed.

**619-4.16 Vehicle Arresting Barrier.** The quantity to be measured for payment will be the number of barriers installed.

**619-4.17 Maintain or Modify Traffic Signal Equipment.** The quantity of signalized intersections maintained to be measured for payment will be in months to the nearest 1/4 month. The quantity of traffic signal equipment modified to be measured for payment will be on an each location basis.

**619-4.18 Temporary Traffic Signals.** The work under temporary traffic signals will be measured for payment on an each location basis.

**619-4.19 Nighttime Operations.** The work under nighttime operations will be measured for payment on a lump sum basis.

**619-4.20 Traffic Control Supervisor.** The work under traffic control supervisor will be measured for payment on a monthly basis to the nearest 1/4 month.

**619-4.21 Temporary Structures and Approaches.** The work performed under temporary structures and approaches will be measured for payment on a lump sum basis.

**619-4.22 Pavement Patching.** The work under Pavement Patching, Winter will be measured for payment on a Dollars-Cents basis.

**619-4.23 Mailboxes.** The quantity to be measured for payment will be the number of mailboxes installed.

## **619-5 BASIS OF PAYMENT**

**619-5.01 General.** The price bid shall include all labor, materials and equipment necessary to complete the work. No payment will be made for damage caused by vehicle accidents, vandalism, or any other similar causes.

**A. Non-Payment.** For each calendar day during which there are substantial deficiencies in compliance with the requirements of this section, no payment will be made under basic work zone traffic control. The amount of such calendar day nonpayment will be deducted from monies due the Contractor in accordance with Table 619-7 *Basic Work Zone Traffic Control Nonpayment*.

<b>TABLE 619-7 BASIC WORK ZONE TRAFFIC CONTROL NON-PAYMENT</b>		
<b>Original Contract Amount</b>		<b>Nonpayment Amount</b>
<b>From More Than</b>	<b>To and Including</b>	
\$ 0	\$ 500,000	\$ 200
\$ 500,000	\$ 2,000,000	\$ 400
\$ 2,000,000	\$ 5,000,000	\$ 500
\$ 5,000,000	\$ 10,000,000	\$ 750
\$ 10,000,000	\$ 20,000,000	\$ 1,000
\$ 20,000,000	-----	\$ 3,000

**B. Liquidated Damages.** If the Contractor fails to adequately correct substantial cited deficiencies within 24 hours of notification by the Engineer for any item under this section, or those deficiencies reoccur on a subsequent, but not necessarily concurrent calendar day, liquidated damages will be assessed for each calendar day or part thereof in addition to non-payment for deficiencies.

**C. Major Non-Conformance.** Where major non-conformance with the requirements of this specification is noted by the Engineer, and prompt Contractor compliance is deemed not to be obtainable, the Engineer may stop contract work.

Where major non-conformance with the requirements of this specification is noted by the Engineer, and the Contractor fails to correct deficiencies for a period of 24 hours, the Department may correct the adverse conditions by any means deemed appropriate, and will deduct the cost of the corrective work from any monies due the Contractor. The cost of this corrective work will be in addition to the non-payment for basic work zone traffic control, non-payment of any other items of work under this section and liquidated damages assessed.

**619-5.02 Basic Work Zone Traffic Control.** The lump sum price bid for basic work zone traffic control shall include all labor, materials, and equipment necessary to complete the work. Construction signs; arrow panels; warning lights on signs, barricades and channelizing devices; the cost of temporarily terminating guide rail, median barrier, or bridge rail during non-work hours; work required to maintain drainage facilities during construction operations; and dust control shall be included in the lump sum price bid for basic work zone traffic control. Removal of debris from drainage features that was present at the time of contract award shall be paid for separately. Progress payments will be made at 10 percent of the lump sum price when the initial construction sign installation is complete, as determined by the Engineer, and an additional 10 percent of the lump sum price bid when 10 percent of the contract work, excluding basic work zone traffic control, contingency items and mobilization, has been completed. The remaining 80 percent will be paid in subsequent contract payments, in proportion to the amount of other contract work completed, less any non-payment for deficient work zone traffic control. If the contract completion date is extended, no additional payment will be made for basic work zone traffic control.

**619-5.03 Basic Work Zone Traffic Control (Daily Operations).** The lump sum price bid for basic work zone traffic control (daily operations) shall include all labor, materials, and equipment necessary to complete the work. Construction signs; arrow panels; warning lights on signs, barricades and channelizing devices; and the cost of temporarily terminating guide rail, median barrier, or bridge rail

during non-work hours; shall be included in the lump sum price bid for basic work zone traffic control (daily operations).

Progress payments will be made at 10 percent of the lump sum price when the initial construction sign installation is complete, as determined by the Engineer, and an additional 10 percent of the lump sum price bid when 10 percent of the contract work, excluding basic work zone traffic control, contingency items and mobilization, has been completed. The remaining 80 percent will be paid in subsequent contract payments, in proportion to the amount of other contract work completed, less any non-payment for deficient work zone traffic control. If the contract completion date is extended, no additional payment will be made for basic work zone traffic control.

**619-5.04 Business Signs.** The unit price bid for temporary business signs shall include the cost of labor, materials and equipment necessary to complete the work, including sign supports.

**619-5.05 Covering or Removal of Pavement Markings.** The unit price bid for the covering or removal of pavement markings shall include the cost of all labor, materials and equipment necessary to complete the work, including the costs of any repairs or replacement of damaged pavement or existing pavement markings resulting from pavement marking removal operations.

**619-5.06 Temporary Pavement Markings.** The unit price bid for temporary pavement markings shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. Payment shall be provided each time temporary pavement markings are first applied on a pavement course in accordance with the contract requirements.

No additional payment shall be provided for the installation of construction signs, temporary delineators, and channelizing devices necessitated by the Contractor's failure to place temporary pavement markings before the pavement is opened to traffic, or for temporary roadside pavement channelization, until edge lines are placed. No additional payment shall be provided for markings required because the Contractor failed to place the next pavement course or the final pavement markings within 14 calendar days.

**619-5.07 Interim Pavement Markings.** The unit price bid for interim pavement markings shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. The work to remove traffic paint or epoxy paint will be paid for separately.

**619-5.08 Temporary Rumble Strips.** The unit price bid for temporary rumble strips shall include the cost of all labor, materials and equipment necessary to complete the work. Payment will include the cost of pavement cleaning, asphalt concrete, and other materials used to form or fill in the rumble strips, and tack coat. On multiyear contracts where it is desired to have rumble strips in place for more than one construction season, the rumble strips will be paid for separately each year they are installed.

**619-5.09 Interim Tubular Markers.** The unit price bid for interim tubular markers shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, including removal and the cost of replacing damaged markers. Interim tubular markers that are in satisfactory condition may be relocated. When interim tubular markers are relocated, payment will be made for another interim tubular marker.

**619-5.10 Portable Variable-Message Signs (PVMS) and Truck Mounted Variable Message Signs (TMVMS).** The unit price bid for PVMS or TMVMS shall include the cost of all labor, materials, testing and equipment necessary to complete the work, including cellular telephone service initial start-up and monthly charges for the cellular communications option. The TMVMS does not require cellular communications service.

Progress payments for PVMS or TMVMS with a pay unit of each will be made for 90 percent of the unit price bid when each unit has been satisfactorily installed and is operational at the first location. The remaining 10 percent will be paid upon removal.

**619-5.11 Type III Construction Barricades.** The unit price bid for Type III construction barricades shall include all labor, materials and equipment necessary to complete the work, including lighting when required. When barricades are relocated or the diagonal stripes are changed to allow traffic to pass on the other side of the barricade, additional payment will be made for another barricade. Movements of the barricade from one side of the roadway to the other side, movements within 100 feet of the initial location, or daily replacement to approximately the same location, not requiring any change in the diagonal stripes, will not be considered as relocation and will not be paid for as additional barricades.

No payment will be made for Type III construction barricades used at the option of the Contractor in lieu of channelizing devices.

**619-5.12 Temporary Positive Barrier.** The unit price bid for temporary positive barrier shall include all labor, materials, and equipment necessary to satisfactorily complete the work, including any required connection devices, end treatments, end section pinning, temporary delineation and repair of pavement after removal of temporary positive barrier. Temporary impact attenuators, if required, will be paid for separately. When temporary positive barriers are relocated, except movements necessary to maintain, realign, or replace damaged units and daily relocation of segments to allow access to the work area which are restored at the end of the work shift, additional payment for the relocation will be made for additional length of temporary concrete barrier.

The unit price bid for temporary positive barrier – Category X shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including pinning.

The unit price bid for warning lights on temporary positive barrier with shall include the cost of furnishing all labor, materials, equipment, and electrical power necessary to complete the work. Should a barrier that is equipped with warning lights be moved to a new location where temporary concrete barrier with warning lights is required, payment will be made for additional warning lights on temporary positive barrier.

The unit price bid for Box Beam to Flared Temporary Concrete Barrier Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail; placement and removal of the temporary berm; seeding of the disturbed area; and replacement of rail with holes in its face. No separate payment will be made for box beam used to provide an overlap.

The unit price bid for Box Beam to Unflared Temporary Concrete Barrier Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail; furnishing of Transition End Pieces, rub rail heavy posts and blockouts; and replacement of rail with holes in its face.

The unit price bid for Temporary Concrete Barrier Face to Box Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail and furnishing of box beam tapered end piece.

The unit price bid for Temporary Concrete Barrier Back to Box Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including removal and replacement or resetting of existing rail and replacement of rail with holes in its face. No separate payment will be made for box beam used to provide an overlap.

The unit price bid for Corrugated Beam to Flared Temporary Concrete Barrier Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including removal and replacement or resetting of existing rail; placement and removal of the temporary berm; seeding of the disturbed area; and furnishing and removal of terminal rail section. No separate payment will be made for corrugated beam used to provide an overlap.

The unit price bid for Temporary Concrete Barrier Face to Corrugated Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work,



including removal and replacement or resetting of existing rail and furnishing and removal of W beam end piece.

The unit price bid for Temporary Concrete Barrier Back to Corrugated Beam Transition shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including removal and replacement or resetting of existing rail and furnishing and removal of terminal rail section. No separate payment will be made for corrugated beam used to provide an overlap.

Progress payments will be made at the unit price bid for 90 percent of the quantity, after placement and demonstration of satisfactory operation. The remaining 10 percent will be paid upon removal. No payment will be made for temporary concrete barrier installed at the Contractor's option, required solely due to a delay caused by the Contractor's operations, or installed to protect pavement edge drop-offs, unless required in the contract documents.

**619-5.13 Temporary Glare Screen.** The unit price bid for temporary glare screen shall include all labor, materials and equipment necessary to complete the work. When glare screens are relocated, except movements necessary to maintain, realign, or replace damaged units and daily relocation of temporary concrete barrier segments with glare screen attached to allow access to the work area which are restored at the end of the work shift, additional payment will be made for the length of glare screen relocated. No payment will be made for repair or replacement of damaged components.

**619-5.14 Temporary Impact Attenuator.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including the connection to temporary or existing barrier, the back-up system, the pad, if indicated, and any excavation or backfill. When attenuators are relocated, payment will be made for a new temporary impact attenuator, except minor movements within a site, such as movements to maintain, realign, or adjust an attenuator. No payment will be made to repair, restore or replace an attenuator damaged by public traffic or by the Contractor's operations.

**619-5.15 Temporary Sand Barrel Arrays.** The unit price bid for temporary sand barrel arrays shall include the cost of all labor, materials and equipment necessary to complete the work, including the cost of the sand fill and salt additive. Replacement of individual modules damaged by public traffic will be paid for at the unit price bid for each temporary sand barrel. Relocation of barrels to a new location will be paid for as a new installation.

**619-5.16 Vehicle Arresting Barrier.** The unit price bid for vehicle arresting barrier shall include the cost of all labor, materials and equipment necessary to complete the work. No payment will be made to repair, restore or replace an attenuator damaged by public traffic or by the Contractor's operations.

**619-5.17 Maintain or Modify Traffic Signal Equipment.** The unit price bid for maintaining traffic signal equipment shall include the cost of all labor, materials and equipment necessary to perform the work, with the exception of inductance loop replacement, if necessary, which will be paid for separately. The cost of the electric power shall be the responsibility of the original maintaining agency. No payment will be made during any period for which the Contractor has been granted an extension of time with engineering charges.

The unit price bid for modifying traffic signal equipment per location shall include the cost of all labor, materials and equipment necessary to perform the work.

**619-5.18 Temporary Traffic Signals.** The unit price bid for temporary traffic signals per location shall include the cost of all labor, materials and equipment necessary to complete the work, including the cost of electric power necessary to operate the signal until its removal is approved or directed by the Engineer. A location may be an intersection, a work zone with two or more signal faces interconnected and operating together, or other limits as defined in the contract documents. Portable or temporary traffic

signals used at the Contractor's option in lieu of flaggers shall be included in the lump sum price bid for basic work zone traffic control.

Progress payments will be made at 50 percent of the unit price bid for each location after installation and demonstration of satisfactory operation. The remaining 50 percent will be paid in progress payments per week of temporary traffic signal provided. The amount of such weekly payment will be determined by dividing 50 percent of the unit price bid by the number of weeks the temporary traffic signal is to remain in operation, as shown on the approved progress schedule.

**619-5.19 Nighttime Operations.** The lump sum price bid for portable lighting shall include all labor, materials and equipment necessary to complete the work.

Progress payments will be made based on the lump sum price bid as follows: 20 percent when the Nighttime Operations and Lighting Plan has been accepted and satisfactory lighting of nighttime operations has begun; the remaining 80 percent will be paid in progress payments per week of nighttime operations completed. The amount of such weekly payment will be determined by dividing 80 percent of the lump sum amount bid by the number of weeks of nighttime operations in the approved Nighttime Operations and Lighting Plan.

**619-5.20 Traffic Control Supervisor.** The unit price bid for traffic control supervisor shall include the cost of furnishing all labor, materials, equipment, training and direct supervision necessary to provide and support the activities of a traffic control supervisor.

**619-5.21 Temporary Structures and Approaches.** The lump sum price bid for temporary structures and approaches shall include the cost of all labor, materials and equipment necessary to complete the work including design preparation, submittals, and inspection of the structure.

Progress payments will be made at the unit price bid for 90 percent of the quantity after the temporary structures and approaches are complete and operable. The remaining 10 percent will be paid upon removal.

**619-5.22 Pavement Patching.** Payment shall include the cost of furnishing all labor, materials and equipment necessary to patch pavement during periods of winter shutdown when work on the contract is inactive, or when hot mix asphalt material is not available, including mobilization of work crews and work zone traffic control. The cost of all work associated with providing and installing suitable pavement patching materials to maintain pavements open to traffic in acceptable condition when work on the contract is active, or when hot mix asphalt material is available, will be paid under a hot mix asphalt sidewalk item if that item is in the contract, or alternatively, under a top course paving item, regardless of the material actually used. Payment for winter patching will be based on force account records submitted to the Engineer, plus 10% overhead and 10% profit in accordance with §109-05.

**619-5.23 Mailboxes.** The unit price bid for mailboxes shall include all labor, materials and equipment necessary to complete the work. Only one payment for each mailbox will be made regardless of the number of times it is moved or replaced and shall be made when the mailbox has been placed in its final location. Where multiple mailboxes are installed on a single post, payment will be based upon the number of individual mailboxes so installed.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
619.01	Basic Work Zone Traffic Control	Lump Sum
619.0101	Basic Work Zone Traffic Control (Daily Operations)	Lump Sum
619.04	Type III Construction Barricades	Each
619.05nn	Temporary Structures and Approaches	Lump Sum
619.0701	Temporary Business Signs	Square Feet

619.0801xx	Remove Pavement Marking Stripes	Feet
619.0802xx	Remove Pavement Marking Letters or Symbols	Each
	<i>xx = Material</i>	
	<i>01 = Traffic Paint,</i>	
	<i>02 = Epoxy Paint,</i>	
	<i>06 = Permanent Pavement Tape</i>	
619.0803	Cover Existing Pavement Marking Stripes (Removable Tape)	Feet
619.0804	Cover Existing Pavement Marking Letters or Symbols (Removable Tape)	Each
619.09xx	Temporary Pavement Markings, Stripes	Feet
	<i>xx = Material</i>	
	<i>01= Traffic Paint,</i>	
	<i>03= Removable Tape,</i>	
	<i>04= Removable Wet Reflective Tape,</i>	
619.1001xx	Interim Pavement Markings, Stripes	Feet
619.1002xx	Interim Pavement Markings, Symbols	Each
619.1003xx	Interim Pavement Markings, Letters	Each
	<i>xx = Material</i>	
	<i>01= Traffic Paint,</i>	
	<i>02= Epoxy Paint,</i>	
	<i>03= Removable Tape,</i>	
	<i>04= Removable Wet Reflective Tape,</i>	
	<i>05= Traffic Paint Supplemented with Raised Markers</i>	
619.1105XY	Portable Variable Message Sign (PVMS) Standard size - Full Matrix (LED)	Each
619.1106XY	Portable Variable Message Sign (PVMS) Standard size - Full Matrix (LED)	Week
619.1107XY	Portable Variable Message Sign (PVMS) Large size - Full Matrix (LED)	Each
619.1108XY	Portable Variable Message Sign (PVMS) Large size - Full Matrix (LED)	Week
619.1109XY	Portable Variable Message Sign (PVMS) Small size - Full Matrix (LED)	Each
619.1110XY	Portable Variable Message Sign (PVMS) Small size - Full Matrix (LED)	Week
619.1111XY	Portable Variable Message Sign (PVMS) Standard size – Line or character matrix (LED)	Each
619.1112XY	Portable Variable Message Sign (PVMS) Standard size – Line or character matrix (LED)	Week
XY = Options		
X= Equipment Options		Y= Cellular Communication Options
1 = No optional equipment specified		1 = No Cellular Communications required
2= Radar		2 = Cellular Communications
3= CCTV Camera		3 = Cellular Communication with NTCIP compliance
4= Radar & CCTV Camera		
619.1113	Truck Mounted Variable Message Signs (TMVMS)	Each
619.1114	Truck Mounted Variable Message Signs (TMVMS)	Week
619.12	Temporary Glare Screen	Feet
619.13nn	Temporary Traffic Signals	Each Location
619.1611	Maintain Traffic Signal Equipment (Requirement A)	Intersection Month
619.1612	Maintain Traffic Signal Equipment (Requirement B)	Intersection Month
619.1613	Maintain Traffic Signal Equipment (Requirement C)	Intersection Month

619.1614nn	Modify Existing Traffic Signal Equipment (Temporary)	Each Location
619.1711	Temporary Positive Barrier – Category 1 (Pinning Prohibited)	Feet
619.1712	Temporary Positive Barrier – Category 2 (Pinning Permitted)	Feet
619.1713	Temporary Positive Barrier – Category 3 (Pinning Prohibited)	Feet
619.1714	Temporary Positive Barrier – Category 4 (Pinning Permitted)	Feet
619.1715	Temporary Positive Barrier – Category 5 (Pinning Prohibited)	Feet
619.1716	Temporary Positive Barrier – Category 6 (Pinning Required)	Feet
619.1717	Temporary Positive Barrier – Category 7 (Pinning and Box-Beam-Stiffening Required)	Feet
619.1719	Warning Lights on Temporary Positive Barriers	Each
619.1720	Box Beam to Flared Temporary Concrete Barrier Transition	Each
619.1721	Box Beam to Unflared Temporary Concrete Barrier Transition	Each
619.1722	Temporary Concrete Barrier Face to Box Beam Transition	Each
619.1723	Temporary Concrete Barrier Back to Box Beam Transition	Each
619.1724	Corrugated Beam to Flared Temporary Concrete Barrier Transition	Each
619.1725	Temporary Concrete Barrier Face to Corrugated Beam Transition	Each
619.1726	Temporary Concrete Barrier Back to Corrugated Beam Transition	Each
619.1802	Temporary Impact Attenuator - Redirective (Test Level 2)	Each
619.1803	Temporary Impact Attenuator - Redirective (Test Level 3)	Each
619.1812	Temporary Impact Attenuator - Gating (Test Level 2)	Each
619.1813	Temporary Impact Attenuator - Gating (Test Level 3)	Each
619.20	Interim Tubular Markers	Each
619.21	Temporary Sand Barrel Module	Each
619.22	Temporary Rumble Strips	Feet
619.23	Vehicle Arresting Barrier	Each
619.24	Nighttime Operations	Lump Sum
619.25	Traffic Control Supervisor	Month
619.2601	Pavement Patching, Winter	Dollars-Cents
619.27	Mailboxes	Each

**NOTE:** nn denotes a serialized pay item.

## **SECTION 620 - BANK AND CHANNEL PROTECTION**

(Last Revised May 1, 2019)

**620-1 DESCRIPTION.** This work shall consist of furnishing all labor, equipment, and materials to place a protective covering of erosion-resistant material in the locations indicated in the contract documents or as directed by the Engineer. The work shall be done in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical sections shown in the contract documents or established by the Engineer.

**620-1.01 Vacant.**

**620-1.02 Stone Filling.** Stone filling shall consist of a layer of well graded stone.

**620-1.03 Dry Rip-Rap.** Dry rip-rap shall consist of a fitted layer of shaped and graded stone.

**620-1.04 Grouted Rip-Rap.** Grouted rip-rap shall consist of a layer of stone, similar to dry rip-rap, with the spaces between the stones filled with cement grout.

**620-1.05 Bedding Material.** Bedding material shall consist of a layer of granular material placed to prevent underlying finer material from passing into and through the stone filling or rip-rap.

**620-1.06 Concrete Block Paving.** Concrete block paving shall consist of concrete blocks placed on embankment slopes under structures as protection against erosion.

**620-1.07 Gabions.** Gabions shall consist of open wire mesh baskets, filled with stones.

**620-2 MATERIALS**

**620-2.01 General.** The requirements for bank and channel protection materials are described below. The procedure for acceptance or rejection of stone filling and rip-rap materials shall be in conformance with the procedures contained in the geotechnical control procedure “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

**620-2.02 Stone Filling.** Provide material meeting the requirements of §733-21 *Stone Filling* for the type of stone filling specified in the contract documents.

**620-2.03 Dry Rip-Rap.** Provide material meeting the requirements of §733-22 *Rip-Rap*, except for §733-22D *Grout*.

**620-2.04 Grouted Rip-Rap.** Provide material meeting the requirements of §733-22 *Rip-Rap*.

**620-2.05 Bedding Material.** Bedding material shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing* for the type of bedding material specified in the contract documents:

**A. Bedding Material Type 1.** Provide material meeting the requirements of §733-23 *Bedding Material Type 1*.

**B. Bedding Material Type 2.** Provide material meeting the requirements of §733-23 *Bedding Material Type 2*.

**620-2.06 Concrete Block Paving.** Provide concrete blocks meeting the requirements of §704-04 *Concrete Block (Slope Paving)*. The blocks shall conform to the dimensions identified in Table 620-1 *Concrete Block Dimensions*:

TABLE 620-1 CONCRETE BLOCK DIMENSIONS		
	Nominal Dimension	Standard Dimension
<b>Length</b>	16 to 20 in.	15 5/8 to 19 5/8 in. (± 1/8 in.)
<b>Thickness</b>	6 in. (solid)	5 5/8 in. (± 1/8 in.)
<b>Width</b>	8 in.	7 5/8 in. (± 1/8 in.)

The size of block used shall be consistent throughout any continuously paved area, and only one nominal length shall be used in any contract. All units shall be sound and free from cracks or other defects that would interfere with the proper placing of the blocks or impair the strength, permanence and appearance of the construction.

Cushion sand for concrete block paving shall meet the requirements of §703-06 *Cushion Sand*. Grout, where used, shall conform to Table 620-2 *Concrete Block Grout Requirements*.

TABLE 620-2 CONCRETE BLOCK GROUT REQUIREMENTS		
Material	Subsection	Grout Mix

TABLE 620-2 CONCRETE BLOCK GROUT REQUIREMENTS		
Portland Cement Type 2	§701-01	1 part
Mortar Sand	§703-03	2 parts

**620-2.07 Gabions.** Provide materials meeting the requirements of §712-15 *Gabions*.

### 620-3 CONSTRUCTION DETAILS

**620-3.01 General.** The ground surface on which bank or channel protection is to be placed shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. All soft or spongy material shall be removed to the depth shown in the contract documents and replaced with approved material. Filled areas shall be compacted in accordance with applicable provisions of Section 203. Protection for structure foundations shall be provided as early as the foundation construction permits. The type of protection shall be placed in accordance with these specifications and the contract documents.

**620-3.02 Stone Filling.** Stone filling shall be placed in a manner that will produce a reasonable well-graded mass of stone with smaller stone fragments filling the space between the larger ones, so as to result in the minimum practicable percentage of voids. The final section of stone filling shall be in conformance with the lines, grades, and thicknesses shown in the contract documents. Stone filling used for bank or channel protection shall be placed to its full course thickness in one operation, unless specified in the special provisions, and in such a manner that the underlying material will not be displaced or worked into the layer of stone filling. Placement of stone upon finished bedding material, when used, shall be carefully controlled to avoid disruption and damage to the layer of bedding material. The stone shall be so placed and distributed that there will be no pockets of uniform size material.

The desired distribution of the various sizes of stone throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing; or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to secure the specified results. When stone filling is dumped under water, methods shall be used that will minimize segregation.

**620-3.03 Dry Rip-Rap.** The stones shall be placed so that the dimension approximately equal to the layer thickness is perpendicular to the slope surface and that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest stones shall be placed at the bottom of the slope. The dry rip-rap shall be properly aligned and placed so as to minimize void spaces between the adjacent stones. The spaces between the stones shall be filled with spalls of suitable size.

**620-3.04 Grouted Rip-Rap.** The procedure of placing the stones shall be the same as described in §620-3.03 *Dry Rip-Rap* except that the space between stones shall be filled with grout rather than spalls. Material upon which the grouted rip-rap is laid shall not be allowed to occupy the space between the stones.

When the stones are in place, the spaces between them shall be completely filled with grout and the surface of the stones cleaned to remove accumulation of grout. Rip-rap shall not be grouted in freezing weather. The grouted rip-rap shall be kept moist for seven days after grouting. A suitable curing compound may be employed, if approved by the Engineer.

The Engineer may direct that occasional spaces be left ungrouted for relief of hydrostatic pressure. The ungrouted spaces shall be chinked with spalls of suitable size.

**620-3.05 Bedding Material.** Where called for in the contract documents, stone filling and dry rip-rap shall be placed on bedding material. The bedding material shall be placed on the prepared area to the full

specified thickness of each layer in one operation, using methods which will not cause segregation of particle sizes. Contamination of bedding material by natural soils or other materials shall be prevented. Bedding material that becomes contaminated shall be removed and replaced with uncontaminated bedding material at no additional cost to the State.

**620-3.06 Concrete Block Paving.** Blocks shall be laid on a 3 in. bed of cushion sand in running bond with the long dimension transverse to the slope and all joints tight. Blocks shall be set slightly higher than their final position and carefully hand tamped into their final position to provide a uniformly even surface and solid bedding under each block.

In the areas where grouting is called for, the block shall be laid in running bond with the length parallel to the slope and with ¼ in. joints. Following the laying of blocks, in the area to be grouted, sufficient mortar sand shall be spread over the surface and swept into the joints to fill the latter to 4 in. from the surface. The block shall be wetted before any grout is placed. The joints shall be filled with grout from the bottom flush with the top of the block.

After grouting has been completed and the grout has sufficiently hardened, the blocks shall be wetted, covered and cured with curing covers for the first seven days after grouting. Grout shall not be poured during freezing weather.

**620-3.07 Gabions.** Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 6 in. spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every 4 in. Empty gabion units shall be set to line and grade as shown in the contract documents. For structural integrity, wire ties or connecting wire shall be used to join the gabions together along the perimeter of all contact surfaces according to the manufacturer's instructions. Internal tie wires shall be uniformly spaced and securely fastened in each outside cell of the structure in accordance with the manufacturer's instructions or where ordered by the Engineer. When gabions are being placed as slope protection, the cross-connecting wire may be deleted if directed by the Engineer.

A fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.

The gabions shall be filled with stone, carefully placed by hand or machine, to ensure alignment and avoid bulges with a minimum of voids. After a gabion has been filled, the lid shall be bent over until it meets the side and edges. The lid shall then be secured to the sides, ends, and diaphragms with wire ties or connective wire in the same manner described above for assembly.

## **620-4 METHOD OF MEASUREMENT**

**620-4.01 General.** Vacant.

**620-4.02 Stone Filling.** Stone filling will be measured in cubic yards, measured to the nearest whole cubic yard, computed from the payment lines shown in the contract documents.

**620-4.03 Dry Rip-Rap.** Dry rip-rap will be measured in cubic yards, measured to the nearest whole cubic yard, computed from the payment lines shown in the contract documents.

**620-4.04 Grouted Rip-Rap.** Grouted rip-rap will be measured in cubic yards, measured to the nearest whole cubic yard, computed from the payment lines shown in the contract documents.

**620-4.05 Bedding Material.** Bedding material will be measured in cubic yards, measured to the nearest whole cubic yard, computed from the payment lines shown in the contract documents.

**620-4.06 Concrete Block Paving.** Concrete block paving will be measured in square yards, measured to the nearest whole square yard, computed from the payment lines shown in the contract documents.

**620-4.07 Gabions.** Gabions will be measured in cubic yards, measured to the nearest whole cubic yard, computed from the payment lines shown in the contract documents.

## **620-5 BASIS OF PAYMENT**

**620-5.01 General.** Vacant.

**620-5.02 Stone Filling.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

**620-5.03 Dry Rip-Rap.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

**620-5.04 Grouted Rip-Rap.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

**620-5.05 Bedding Material.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

**620-5.06 Concrete Block Paving.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

**620-5.07 Gabions.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work except that any necessary excavation will be paid for separately.

### ***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
620.02	Stone Filling (Fine)	Cubic Yard
620.03	Stone Filling (Light)	Cubic Yard
620.04	Stone Filling (Medium)	Cubic Yard
620.05	Stone Filling (Heavy)	Cubic Yard
620.06	Dry Rip-Rap	Cubic Yard
620.07	Grouted Rip-Rap	Cubic Yard
620.0801	Bedding Material, Type 1	Cubic Yard
620.0802	Bedding Material, Type 2	Cubic Yard
620.09	Concrete Block Paving	Square Yard
620.10	Galvanized Gabions	Cubic Yard
620.11	P.V.C. Coated Galvanized Gabions	Cubic Yard

## **SECTION 621 - CLEANING CULVERTS, DRAINAGE STRUCTURES AND EXISTING ROADSIDE SECTIONS**

### **621-1 DESCRIPTION**



**621-1.01 General.** This work shall consist of cleaning and keeping clean, existing culverts, closed drainage systems, drainage structures, and existing roadside sections as shown in the contract documents.

**621-1.02 Definitions.** The following general definitions shall be used in conjunction with this section:

1. **Culvert.** A culvert is defined as an enclosed channel open at both ends carrying water from a stream or water course through an artificial barrier such as a roadway embankment.
2. **Closed Drainage System.** A closed drainage system is a collection system for stormwater runoff that carries water to a discharge point. A closed drainage system consists of enclosed channel(s) closed at either one or both ends by a drainage structure, and may include intermediate drainage structures at junction points.
3. **Drainage Structure.** A drainage structure includes catch basins, manholes, drop inlets, leaching basins and similar structures that collect and/or redirect runoff water.
4. **Materials Removed.** Materials removed have been presumed not to include non-hazardous industrial waste or hazardous waste in accordance with §107-10 *Managing Surplus Material and Waste*.
5. **Clean and Keeping Clean.** Clean and keeping clean is the activity of removing accumulated sediment, debris, and vegetation which impedes the flow of water to maintain a proper drainage path and re-establish the design capacity.
6. **Graded Surfaces.** Grading surfaces entails forming and trimming surfaces to the lines and grades shown in the contract documents.

**621-2 MATERIALS.** None specified.

### **621-3 CONSTRUCTION DETAILS**

**621-3.01. General.** Provide appropriate control and discharge practices for all water throughout the cleaning process. Include methods and schedules to be consistent with the soil erosion and sediment control plan in accordance with §209-3.01 *General* and perform all work in accordance with §107-12 *Water Quality Protection*.

**621-3.02. Cleaning Culverts.** Culvert locations identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. *Disposal of Surplus Excavated Materials*. Removal of contaminated material shall be disposed of in accordance with Section 205 *Contaminated Soil*.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.

**621-3.03 Cleaning Closed Drainage System.** Closed drainage systems identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. *Disposal of Surplus Excavated Materials*. Removal of contaminated material shall be disposed of in accordance with Section 205 *Contaminated Soil*.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.

**621-3.04 Cleaning Drainage Structures.** Drainage structures identified in the contract documents shall be cleaned. Materials removed shall be disposed of in accordance with §203-3.02 B. *Disposal of Surplus Excavated Materials*. Removal of contaminated material shall be disposed of in accordance with Section 205 *Contaminated Soil*.

It is not guaranteed that placement of surplus materials of spoil will be allowed within the right of way. Additionally, disposal of turbid water generated via the cleaning process shall be subject to appropriate environmental regulations.

**621-3.05 Cleaning, Grading and Shaping Existing Roadside Section.** The Contractor shall remove earth, turf, brush and debris, or provide necessary fill material to restore adequate roadside drainage. Ditches shall be shaped as shown in the contract documents. Material removed shall be disposed of in conformance with the provisions of §203-3.02 B. *Disposal of Surplus Excavated Materials*. Removal of contaminated material shall be disposed of in accordance with Section 205 *Contaminated Soil*.

The Contractor shall protect all fences, markers, culverts, underground structures, utilities and other appurtenances adjacent to the work area. Any damaged facilities and/or disturbed areas shall be replaced in kind at no additional cost to the state.

#### **621-4 METHOD OF MEASUREMENT**

**621-4.01. General.** None specified.

**621-4.02. Cleaning Culverts.** Cleaning culverts will be measured in linear feet of culvert cleaned, measured along the invert, to the nearest foot. Multiple barrel culverts will be measured along each individual barrel.

**621-4.03 Cleaning Closed Drainage System.** Cleaning closed drainage systems will be measured in linear feet of pipe cleaned, measured along the invert of the pipe, from the inside wall surface of the drainage structure to the inside wall surface of the next drainage structure, measured to the nearest foot.

**621-4.04 Cleaning Drainage Structures.** Cleaning drainage structures will be measured as the number of drainage structures cleaned.

**621-4.05 Cleaning, Grading and Shaping Existing Roadside Section.** Cleaning, grading, and shaping existing roadside section will be measured as the number of linear feet along the edge of the adjacent roadway.

#### **621-5 BASIS OF PAYMENT**

**621-5.01. General.** None specified.

**621-5.02. Cleaning Culverts.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the culverts. Payment for cleaning culverts will be made only for those facilities designated in the contract documents. Only one payment for each length of facility will be made regardless of the number of times it is cleaned.

**621-5.03 Cleaning Closed Drainage System.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the closed drainage system. Payment for cleaning closed drainage systems will be made only for those facilities designated in the

contract documents. Only one payment for each facility will be made regardless of the number of times it is cleaned. Cleaning intermediate drainage structures at junction points within a closed drainage system shall be paid for under its respective item.

**621-5.04 Cleaning Drainage Structures.** The unit price bid for each shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work including the cost of managing and disposing the materials used to clean and the materials removed from the drainage structures. Payment for cleaning drainage structures will be made only for those facilities designated in the contract documents. Only one payment for each facility will be made regardless of the number of times it is cleaned.

**621-5.05 Cleaning, Grading and Shaping Existing Roadside Section.** The unit price bid shall include the costs of furnishing all labor, material and equipment necessary to complete the work including the cost of disposing the materials removed from the roadside section and/or fill material to restore the shape.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
621.01	Cleaning Culverts with Span of 50 in. or Less	Linear Foot
621.02	Cleaning Culverts with Span of More Than 50 in.	Linear Foot
621.03	Cleaning Closed Drainage Systems	Linear Foot
621.04	Cleaning Drainage Structures	Each
621.05	Clean, Grade and Shape Existing Roadside Section	Linear Foot
621.11	Cleaning Culverts (Contaminated Material) with Span of 50 in. or Less	Linear Foot
621.12	Cleaning Culverts (Contaminated Material) with Span of More Than 50 in.	Linear Foot
621.13	Cleaning Closed Drainage Systems (Contaminated Material)	Linear Foot
621.14	Cleaning Drainage Structures (Contaminated Material)	Each
621.15	Clean (Contaminated Material), Grade and Shape Existing Roadside Section	Linear Foot

## **SECTION 622 - BUILDINGS AND MISCELLANEOUS STRUCTURES**

**622-1 DESCRIPTION.** This work shall consist of special construction, reconstruction and maintenance of rest areas/comfort stations; pump houses; elevators; shade structures & canopies; construction, furnishing and placing bus shelters, kiosks and other miscellaneous structures.

**622-2 MATERIALS.** Materials shall be as specified in the special specifications.

**622-3 CONSTRUCTION DETAILS.** As specified in the special specifications.

**622-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**622-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 623 - SCREENED GRAVEL, CRUSHED GRAVEL, CRUSHED STONE, CRUSHED SLAG**

**623-1 DESCRIPTION.** This work shall consist of furnishing and placing, as shown on the plans or directed by the Engineer, screened gravel, crushed gravel, crushed stone, or crushed slag.

**623-2 MATERIALS.** The materials shall meet the requirements of §703-02, Coarse Aggregates, unless otherwise indicated, and shall be furnished in the sizes or combination of sizes indicated on the plans or ordered by the Engineer.

**623-3 CONSTRUCTION DETAILS.** Screened gravel, crushed gravel, crushed stone or crushed slag shall be placed as shown on the plans or as directed by the Engineer.

**623-4 METHOD OF MEASUREMENT**

**623-4.01 Measurement by Weight.** The quantity to be paid for shall be the number of tons, loose measure, incorporated into the work conforming to the requirements of these specifications and in accordance with the lines, grades, and cross-sections shown on the plans or as directed by the Engineer.

**623-4.02 In-Place Measure.** The quantity to be paid for shall be the number of cubic yards of material placed, measured in the completed work, within the payment lines, as shown on the plans or as ordered by the Engineer.

**623-5 BASIS OF PAYMENT.** The unit price bid shall include costs of all labor, material and equipment necessary to properly complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
623.01	Screened Gravel (By Weight)	Ton
623.02	Crushed Gravel (By Weight)	Ton
623.03	Crushed Stone (By Weight)	Ton
623.04	Crushed Slag (By Weight)	Ton
623.10	Screened Gravel (In-Place Measure)	Cubic Yard
623.11	Crushed Gravel (In-Place Measure)	Cubic Yard
623.12	Crushed Stone (In-Place Measure)	Cubic Yard
623.13	Crushed Slag(In-Place Measure)	Cubic Yard

**SECTION 624 - PAVED GUTTERS**

**624-1 DESCRIPTION.** This work shall consist of the construction of Hot Mix Asphalt, precast, conventionally formed or machine formed Portland Cement concrete, or cobblestone gutters in accordance with these specifications and in reasonably close conformity with the lines and grades indicated in the Contract Documents and/or as directed by the Engineer.

**624-2 MATERIALS**

**624-2.01 Hot Mix Asphalt Gutters.** The materials for hot mix asphalt gutters shall meet the requirements specified for a 9.5 mixture designed for <0.3 million Equivalent Single Axle Loads, ESALs using coarse aggregate Type F9.

**624-2.02 Conventionally Formed Concrete Gutters.** The materials and manufacture of concrete for this work shall meet the requirements for Class A concrete specified in Section 501 Portland Cement Concrete - General.

**624-2.03 Precast Concrete Gutters.** Precast concrete gutters shall comply with the requirements of §714-07, Precast Concrete Gutters.

**624-2.04 Cobble Gutters.** Cobble gutters shall be made of rounded “Hardheads,” 6 inch to 10 inch in diameter.

**624-2.05 Machine Formed Concrete Gutter.** The material requirements, mix preparation and manufacturing of concrete shall comply with the requirements for Class I concrete, as specified in Section 501 Portland Cement Concrete-General.

### **624-3 CONSTRUCTION DETAILS**

**624-3.01 Hot Mix Asphalt Gutters.** Except as provided below, the construction requirements shall meet those of §402-3, Construction Details for Hot Mix Asphalt (HMA) Pavements.

*A. Preparation of Bed.* The location of the gutter shall be properly excavated and graded to conform with the gutter cross-section and line and grade. The excavated area shall be firm and dry before laying the gutter.

*B. Placing.* The Hot Mix Asphalt may be placed by handwork or by a paving machine approved by the Engineer. The gutter shall be uniform in texture, shape and density. The asphalt may be placed in a single layer providing that the section, line and grade after compaction are determined satisfactory by the Engineer.

*C. Sealing.* After compaction, the finished surface of the gutter shall be sealed by an application of bituminous material, Material Designation 702-3001, in the quantity and manner directed by the Engineer.

**624-3.02 Conventionally Formed or Machine Formed Concrete Gutters.** Concrete gutters shall be either conventionally formed or machine formed to the size and shape shown on the Standard Sheets.

#### *A. Conventionally Formed Gutters.*

*1. General.* Unless otherwise indicated, concrete gutters shall be constructed in 8 foot sections of the shapes and types shown on the plans and/or Standard Sheet with 1/4 inch joints between sections. The gutter may be constructed in alternate sections, 24 hours to elapse before the construction of the intermediate sections. Excess concrete shall be screeded off perpendicular to the line of the gutter.

All construction joints shall be poured full with material meeting the requirements of Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.

*2. Curing.* Curing of the gutters shall comply with the requirements of §502-3.11, Curing. Minimum curing periods for the various types of curing materials shall comply with the requirements of Table 502-3. A clear membrane curing compound may be used in lieu of a white-pigmented membrane curing compound.

*B. Machine Formed Gutter.* The machine forming requirements of concrete curb as specified under §609-3.04 shall apply except that crack control joints, 1/4 inch wide, shall be formed or scored every 8 feet to depths sufficient to produce weakened planes in the concrete. All crack control joints shall be filled flush with material meeting the requirements of Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.

**624-3.03 Precast Concrete Gutters.** The location of the gutter shall be excavated and graded to conform with the gutter cross-section and line and grade. Gutter sections shall be placed to line and grade on a firm and dry subgrade.

All joints shall be poured full with material meeting the requirements of Material Designation 702-0700, Miscellaneous Asphalt Cement or §705-02 Highway Joint Sealants, Type IV.

**624-3.04 Cobble Gutters.** The largest stones shall be selected and set along the inner edge and the center of the gutter. All stones shall be embedded in mortar composed of one part Type 1 or 2 cement, §701-01, and two parts of §703-07, Concrete Sand. All stone shall be laid to line and grade, with close joints, by skilled workmen using regular paving tools. The stones shall then be thoroughly rammed in place and brought to a uniform surface.

The joints shall be made of the same mortar as described above. The mortar shall completely fill the joints after being tamped.

#### **624-4 METHOD OF MEASUREMENT**

**624-4.01 Hot Mix Asphalt Gutters.** The quantity of asphalt gutters to be paid for will be measured by the number of tons of Hot Mix Asphalt furnished and placed in accordance with the Contract Documents and/or as directed by the Engineer. Quality payment adjustments will be measured as outlined in §402-4, Method of Measurement.

**624-4.02 Conventionally Formed or Machine Formed Concrete Gutters.** The quantity to be paid for under this work will be the number of square feet of exposed surface of concrete gutters placed in accordance with the Contract Documents and/or as directed by the Engineer. No reduction in the number of square feet will be made to account for drainage structure frames and grates, or any other obstruction placed within the gutter section.

**624-4.03 Precast Concrete Gutters.** The quantity to be paid for under this item will be the number of feet of gutter (laying length) placed in the work in accordance with the Contract Documents and/or as directed by the Engineer.

**624-4.04 Cobble Gutters.** The quantity of cobble gutters to be paid for under this work will be the number of square feet of exposed surface laid in accordance with the Contract Documents and/or as directed by the Engineer.

#### **624-5 BASIS OF PAYMENT**

**624-5.01 Hot Mix Asphalt Gutters.** The unit price bid per ton of Hot Mix Asphalt shall include the cost of furnishing all materials including the asphalt cement, the mixing, transporting, grading, placing, rolling and all equipment and labor necessary to complete the work including all necessary excavation below the finished surface, exclusive of any undercutting or excavation for special bedding materials. Payment of Quality Units will be made based on the Index Price listed in the Contract Documents . The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the Contract.

**624-5.02 Conventionally Formed or Machine Formed Concrete Gutters.** The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including all necessary excavation below the finished surface exclusive of any undercutting or excavation for special bedding materials.

**624-5.03 Precast Concrete Gutters.** The provisions of §624-5.02 shall apply.

**624-5.04 Cobble Gutters.** The provisions of §624-5.02 shall apply.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
624.01XX	Conventionally Formed or Machine Formed Concrete Gutters	Square Foot
624.020101	Hot Mix Asphalt Gutter	Ton
624.020110	Plant Production Quality Adjustment to 624.020101	Quality Unit
624.020601	Hot Mix Asphalt Gutters, as Detailed	Ton
624.020610	Plant Production Quality Adjustment to 624.020601	Quality Unit
624.03XX	Precast Concrete Gutters	Foot
624.0401	Cobble Gutters	Square Foot

Refer to the Standard Contract Pay Item Catalog for full Item Number and full Description.

## **SECTION 625 - SURVEY OPERATIONS**

(Last Revised May, 2018)

### **625-1 DESCRIPTION**

#### **625-1.01 General.**

Some survey work is required be completed under the direction of a Land Surveyor or Professional Engineer in accordance with the professional license requirements contained in NYS Education Law.

#### **625-1.02 Survey Operations.**

This work shall consist of providing all necessary survey work to establish, spatially position, and verify the locations of existing and proposed terrain features and measure quantities of items in accordance with the contract documents or as directed by the Engineer. This work includes but is not limited to the establishment, reestablishment or localization of primary and secondary control, the stakeout or layout of proposed features, the initialization, calibration and navigation of automated equipment operations, the location or verification of existing terrain or of constructed features, the verification of geospatial data for proposed construction work and the coordination and sharing of engineering data with the Department or other contract stakeholders.

#### **625-1.03 Right of Way Markers.**

This work shall consist of furnishing, installing and certifying right of way markers at the positions described on the right of way appropriation maps, in accordance with the contract documents and the Standard Sheet.

#### **625-1.04 Permanent Survey Markers.**

This work shall consist of furnishing, installing, and certifying permanent survey markers in accordance with the details shown on the appropriate Standard Sheet.

#### **625-1.05 Supplemental Site Survey.**

This work shall consist of providing all necessary field survey and terrain mapping necessary to locate, spatially position, verify and digitally map the locations of existing above or below ground terrain features as described in the contract documents or as directed by the Engineer. The limits of this supplemental survey will be described in the contract documents.

### **625-1.06 GPS Inspection Units.**

This work shall consist of furnishing, configuring, installing, maintaining and removing Global Positioning System (GPS) units as needed for use by the Engineer and their inspection staff, including the training of the Engineer and their representatives on the use of the GPS units provided.

## **625-2 MATERIALS**

**625-2.01 General.** None specified.

**625-2.02 Survey Operations.** None specified.

### **625-2.03 Right of Way Markers.**

#### **A. Concrete Right of Way Markers.**

Concrete ROW Markers shall conform to the requirements of §712-05 *Precast Concrete Right-of-Way Markers*, and shall be in accordance with the details shown on the Standard Sheet.

#### **B. Steel Pin and Cap Right of Way Markers.**

Reinforcing steel used for the shank shall conform to ASTM A615, Grade 300 or Grade 420. It shall be epoxy coated for its entire length in accordance with §705-14 *Longitudinal Joint Ties* or §709-04 *Epoxy Coated Bar Reinforcement*.

The cap shall be aluminum or a corrosion resistant aluminum alloy. The cap shall weigh a minimum of 50 grams and fasten to the shank by means of threading or force fitting.

A commercial grade silicone sealant shall be used between the cap and the shank.

Steel Pin and Cap-Type Markers shall be anchored into rock using Concrete Grouting Material meeting the requirements of §701-05 *Concrete Grouting Material*.

**625-2.04 Permanent Survey Markers.** The concrete shall meet the requirements of Class A Concrete in Section 501 Portland Cement Concrete--General, except that the requirements for inspection facilities, automated batching controls and recordation do not apply. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to Class A Concrete. The Contractor has the option to use precast permanent survey markers in place of cast in place units. Precast units shall meet §712-24.

**625-2.05 Supplemental Site Survey.** None specified.

### **625-2.06 GPS Inspection Units.**

Each GPS Unit shall include all necessary components, communication devices, integrated antennae and receiver, controller and/or data collector, cables, software, operating manuals, attachments, and fastening hardware to meet the minimum requirements described below.

#### **A. All GPS Inspection Units.**

1. All GPS units provided for a single contract shall be of the same model and manufacturer; and shall include, and be licensed to operate, the same versions of GPS planning software, data collection software, navigation software, stakeout software and post processing software. All software provided (including firmware) shall be the most current available from the manufacturer at the time of delivery of the GPS units. GPS units should be of the same manufacturer as those used by the Contractor. GPS units shall not be more than 2 years old from the date of



manufacturing to the time of delivery. To verify the age of the GPS units, the Contractor shall provide a dated copy of the manufacturer's receipt(s) for the purchase, lease or rental of the units.

2. GPS units shall include both standard USB cable and Bluetooth wireless technology for data transfer.
3. Data shall be capable of being copied onto or from a removable industry standard data storage card (eg: secure digital SD Card). Each GPS Unit shall include 2 data storage cards, each with a minimum capacity of 4 GB.
4. GPS units shall include the ability to import/export and display point and alignment data which is in XML format, and also import graphics files which are in DGN or DXF format.
5. GPS units shall have an internal, or modular, rechargeable battery system capable of operating a minimum of 8 hours (may include interchangeable batteries), including the battery charger.
6. GPS units shall include a hard or soft shell carry case, and all appropriate operation manuals.

#### ***B. Survey Grade GPS Inspection Units.***

1. GPS units shall be equipped to receive Global Positioning System (GPS), GLONASS and GNSS position data.
2. GPS units shall be equipped to receive, and be capable of utilizing, Real Time Kinematics (RTK) correctional data (current version of RTCM format) through internet protocol as provided from the NYS Continuously Operating Reference System (NYS CORS) Network. This shall include all necessary communication devices, repeaters and systems, data service plans and communications to meet the minimum required accuracy and not exceed a 2 second latency at the rover. Whichever communication method is utilized by the Contractor to broadcast the NYS CORS RTK correctional data, the Contractor shall ensure that the RTK data shall be available at all locations across the entire contract site during all hours of construction and inspection operations.
3. GPS units shall include the capability to "localize" both the horizontal and vertical control to local project monumentation (also known as calibrate), while utilizing RTK corrections from a reference network.
4. GPS units shall include either an integrated or modular communication device capable of receiving RTK correctional data to satisfy the requirement of using NYS CORS RTK corrections.
5. GPS units shall have the ability to display the number of satellites tracked at any one time, and indicate the accuracy quality of each measurement relative to the strength of signals, and the GDOP (Geometric Dilution of Precision).
6. GPS Unit shall include dual frequency receivers.
7. Minimum Required Kinematic Accuracy relative to primary project control (CORS):  
Horizontal: 0.033 ft + 1.0 ppm; Vertical: 0.065 ft + 1.0 ppm
8. All necessary hardware and software shall be included (including communication drivers) to connect the GPS unit to a Department provided Tablet PC and communicate/exchange positional data with Bentley™ OnSite software. Firmware used on the GPS unit shall be verified as interoperable with Bentley™ OnSite software. If the firmware cannot be verified as being interoperable with Bentley™ OnSite, the next older version may be used.
9. The data controller shall permit the user to program and store multiple configurations (also known as user preferences) prior to the actual field measurements. Configurations shall be capable of being stored and recalled in the field.
10. GPS units shall include one fixed height rover rod of 6.56 feet in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.
11. A GPS unit set up to operate as a base station shall include all necessary additional cables, hardware, fasteners or accessories necessary to install it in a fixed semi-permanent location, . will not be considered as a rover unit, and therefore will not require a rover rod, a bi-pod, or a topo shoe.

**C. Mapping Grade GPS Inspection Units.**

1. Minimum Required Kinematic Accuracy: less than 3.0 feet in real time.
2. GPS units shall also provide standard support for the Wide Area Augmentation System (WAAS) position correction services.

**625-3 CONSTRUCTION DETAILS**

**625-3.01 General.**

**A. Professional Responsibilities.**

The following types of Survey Operations shall be completed by the Contractor under the direction of a Land Surveyor. This requirement is directly or indirectly associated with the professional license requirements contained in Article 145 of the NYS Education Law.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
  - a. Establishing boundaries of new right of way appropriated for this contract.
  - b. Location of property or highway boundary markers.
  - c. Tie measurements to, or resetting of control points.
2. Location or resetting of existing highway and property boundary markers by reference ties to or from contract control to protect their integrity.
3. Establishment or certification of location of right of way markers and permanent survey markers.

The following types of Survey Operations shall be completed by the Contractor under the direction of either a Land Surveyor or Professional Engineer.

1. Establishment, reestablishment or localization of primary or secondary control which shall be used for:
  - a. Establishing location for horizontal or vertical roadway alignment.
  - b. Establishing location for the horizontal or vertical alignment of a structure.
  - c. Establishing or localizing reference base station for Global Positioning System (GPS) control work.
2. Establishing new horizontal or vertical roadway alignment in the field from contract control either by conventional stakeout methods or by use of automated equipment operations.

**B. Survey/Engineering Geospatial Data.**

All establishments or reestablishment of contract primary or secondary control, and the survey collection of terrain data shall be performed in accordance with the standards and procedures required in the Department's *Land Surveying Standards and Procedures Manual*. The Contractor shall incorporate the NYS CORS network into contract control to facilitate the use of GPS survey within the site and on the same datum by other project stakeholders, or to align with other adjacent projects.

When the Department provides electronic copies of engineering data to the Contractor, files should follow the standard file naming conventions listed in Appendix 14 of the Department's *Project Development Manual*.

- 1. Existing Terrain Data.** When an existing digital terrain model was developed during design and provided for construction purposes, and possibly updated during construction by supplemental survey, the Department and Contractor shall use that information as a basis from

which to develop contract pay item quantities. The Contractor shall consider all existing terrain data supplied by the Department as being within acceptable tolerances, except where changes or additions have been approved by the Engineer. If the Contractor questions the accuracy of the existing terrain data provided, the Contractor may verify any or all portion(s) of the existing terrain model, at no additional cost to the State, in accordance with §105-10 *Survey and Stakeout*. All exceptions or discrepancies found with the supplied existing terrain data shall be brought to the attention of the Engineer, in writing, and terrain data modifications shall be mutually agreed upon and shared with both parties prior to beginning construction operations within those areas being modified. Changes to existing terrain data will not be accepted by the Department where existing terrain is verified to be within Departmental accepted positional tolerances in accordance with the Department's *Land Surveying Standards and Procedures Manual*, or after the Contractor has disturbed the existing ground surface.

**2. Proposed Data.** When proposed digital terrain models (or surfaces), proposed alignments and proposed graphics were developed during design and provided for construction purposes, or revised during construction due to site changes or redesign, the Department and Contractor shall use that information from which to position and compute applicable contract pay item quantities and to field verify positional locations of constructed items. When the Contractor and Department agree to utilize the proposed digital terrain data (surface), alignments or graphics the Contractor shall first review its consistency with all other contract information, and review for any perceived physical conflicts or inconsistencies of information prior to using the data in the field for any construction purpose. All exceptions or discrepancies with the supplied data shall be brought to the attention of the Engineer, in writing, and terrain data, alignment or graphics modifications shall be approved by the Engineer prior to beginning construction operations within those areas being modified. All approved changes shall be shared electronically with both the Department and the Contractor, and both parties shall acknowledge acceptance of such changes before beginning the work.

When proposed digital terrain model (or surfaces), alignments or graphics are not provided by the Department, the Contractor may choose to develop their own terrain model surfaces from the contract plans to facilitate their use of Automated Machine Guidance, at no additional cost to the State. A request by the Contractor to use Automated Machine Guidance shall be made as part of the Contract Control Plan. The Contractor developed terrain model surfaces shall be shared with the Engineer in a Department accepted format prior to beginning construction operations. Generation of proposed terrain model surfaces or other electronic engineering data does not constitute a redesign of the project, and the Contractor retains all responsibility to complete the work in accordance with the engineering intent conveyed in the contract documents unless otherwise agreed to in writing by the Engineer.

### **625-3.02 Survey Operations.**

All Survey Operations shall follow either Traditional *Survey Stakeout* or Automated Stakeout and *Automated Machine Guidance Operations*, or a combination of both, for the establishment, positioning, equipment guidance or verification of construction items. The proposed method shall be approved by the Engineer as part of the Contract Control Plan prior to beginning any field construction operations. Both methods include the same basic requirements that: (1) both parties (Contractor and Department) utilize the same contract control, the same existing terrain data, and the same proposed feature data; (2) both parties utilize the same accuracy and tolerance limits; and (3) both parties utilize equivalent survey verification techniques to ensure that field features are constructed as proposed.

The Contractor shall establish the center line of bearings for all bridge abutments and piers, by setting offset hubs or reference points, so located and protected to ensure they remain undisturbed until such time as they are no longer needed. The Contractor shall mark the location of anchor bolts to be installed, establish the elevation of bearing surfaces and check bearing plates to ensure installation at their proper

elevation. Before the erection of structural steel or concrete beams the Contractor shall verify the locations, both vertically and horizontally, of all bearings and the distances between associated bearings. Control used to establish center line of bearings shall be included in the contract control plan.

On contracts which include proposed and existing roadway alignments and profiles, the Contractor shall verify the roadway tie-in locations of where existing and proposed alignments meet prior to beginning construction operations and report the results to the Engineer. This requirement is intended to verify that no changes have occurred to the existing roadway and that the proposed design is buildable as designed.

#### ***A. Contract Control Plan.***

The Contractor shall develop and submit a Contract Control Plan for all contracts which include the contract pay item for Survey Operations. Contract control includes all statewide or local primary and secondary horizontal and vertical control which will be used for the geospatial positioning of work items. Upon the Contractor's completion of initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document which is to be signed and sealed by a Land Surveyor or Professional Engineer in accordance with §625-3.01.A *Professional Responsibilities*, for acceptance by the Engineer. The Contract Control Plan shall include the below listed required control information and follow the acceptance procedure.

All revisions or additions to contract control for the purpose of stakeout or layout of proposed work items shall be provided in writing to the Engineer prior to beginning that revised portion of stakeout or layout work.

##### ***1. Acceptance Procedure.***

- a. The Contractor shall document required information and submit electronically to the Engineer at least 10 work days prior to beginning field operations.
- b. The Engineer will coordinate review with the Regional Land Surveyor and provide comments.
- c. Upon acceptance of the procedure by the Engineer, the Contractor shall submit 2 signed and sealed copies to the Engineer.

##### ***2. Control Information.***

The Contractor shall list the following control information (tabular format is acceptable):

- a. All contract control shown in the contract documents or in the Survey Control Report.  
Note: The NYS CORS Network provides primary control for most Department contracts.
- b. The following elements shall be submitted for all contract control points or benchmarks:
  - (1) Recovered in the field and did it appear undisturbed?
  - (2) Contract indicated coordinate or elevation.
  - (3) Field determined coordinate or elevation.
  - (4) Contractor adjusted coordinate or elevation, if necessary.
  - (5) Point or benchmark intended to be used for construction purposes.
- c. Adjustment method is used to balance or adjust the control (ex: Compass Rule for Baseline or Calibration Report for GPS, etc). Attach a copy of the adjustment/calibration report.
- d. Control network diagram (drawn to a legible scale) with roadways indicated.
- e. New York State Plane Coordinate System (NYSPCS) Zone utilized.
- f. Horizontal Datum used.
- g. Vertical Datum used.

- h. Combined Factor used to account for the ellipsoidal reduction factor and the grid scale factor.
- i. Additional (new) control is anticipated to be needed and where will they be set?
- j. When a GPS base station(s) is utilized on a project either for inspection or stakeout, provide the determined coordinate and elevation value of the station, and the datum differential from that localized value to a NYS CORS determined value.

### **3. Methods or Procedures.**

The Contractor shall document and provide the following survey information on methods or procedures to be used:

- a. Survey method used to verify the control (ex: Total Station, GPS/RTK, Auto Level, etc).
- b. Survey method(s) used to stakeout which types of proposed features.
- c. Survey method(s) used to stakeout proposed ROW Markers.
- d. Survey method used for stakeout of proposed bridge structures (if applicable). How will control be set up and maintained around the bridge(s)?
- e. Proposed manufacturer, model and software version for GPS Inspection Units.
- f. Automated Machine Guidance (AMG) proposed for use on this contract.
- g. Type and frequency of quality control measures included to maintain the proper calibration and adjustment of the AMG systems.
- h. If GPS will be used for stakeout or for AMG, will the NYS CORS Network be used as its reference network or will base station(s) be used?
- i. If a base station is to be used, describe the mounting location, attachment technique, and instrumental protection included which ensures a sound and reliable reference station will be provided.

### **B. Traditional Survey Stakeout.**

The Contractor shall field locate all features to be constructed from survey control points which are identified in the Contract Control Plan. Any error, apparent discrepancy or absence in the data shown or required to appropriately accomplish the stakeout survey shall be referred to the Engineer immediately for interpretation when such is observed or required.

The Contractor shall place two offset stakes or reference points along the center line at maximum intervals of 50 feet and at such intermediate locations as required to determine location and direction. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the center line station number, offset and cut or fill from which the establishment of the centerline location and elevation can be determined. If markings become illegible for any reason the markings shall be restored by the Contractor. The Contractor shall locate and place all cut, fill, slope, fine grade, or other stakes and points for the proper progress of the work with a maximum station spacing of 50 feet. All control points shall be properly protected and flagged for easy identification.

The Contractor shall be responsible for the accuracy of the work and shall maintain all applicable reference points, stakes, etc. Damaged or destroyed reference points or bench marks made inaccessible by the progress of the construction shall be replaced or transferred by the Contractor. All control points shall be referenced by ties (4 minimum) to specific points on acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer. All stakeout survey work related to highway control shall be referenced to the control line (or survey baseline) shown in the contract documents. Computations and survey notes necessary to establish the position of the work from control points, shall be made and maintained in a neat, legible and acceptable format by the Contractor. Computations, survey notes and other survey information shall be made available to the Engineer within 3 work days from the request. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor.

Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of the work.

**C. Automated Stakeout and Automated Machine Guidance Operations.**

Should the Contractor choose automated methods for the establishment, layout, measurement, equipment guidance or verification of work to be constructed, they shall submit their proposed automated methods including quality control measures as part of their contract control plan for acceptance by the Engineer. When utilizing these methods, all horizontal and vertical survey control, roadway alignment control, existing terrain data and proposed design engineering data shall be shared/exchanged electronically and kept current between the Contractor and the Engineer. All original version files of electronic contract data shall be maintained and stored by the Department. Prior to beginning field operations, the Contractor and Engineer shall mutually determine acceptable uses of and procedures for the technology being used, and how data can be exchanged for use in stakeout, automated machine operations, positional verification, quantity measurements and calculations. All record copies of engineering data shall be stored and shared in Department accepted standard formats, and shall be derived primarily from the original electronic data, when provided by the Department.

Automated survey operations have a high reliance on accurate control networks from which to make measurements, establish positions, and verify geospatial locations of features. Therefore, a strong contract control network in the field which is consistent with the project control used during the design of the contract is essential to the successful use of these technologies with the proposed digital terrain model and alignments. Consistent and well designed site calibration (localization) for all automated machine guidance, as described above under *Contract Control Plan*, is required to ensure the quality of the contract deliverables. The Contract Control Plan is intended to document which local horizontal and vertical control will be used for calibration during construction operations and how that calibration or adjustment will be maintained along the entire contract length. Continued incorporation of NYS CORS Network is essential to maintaining the integrity of positional locations and elevations of features.

The Engineer may perform quality assurance verifications of feature positions at any time during the contract. Dimensional tolerances shall hold a higher order of precedence than positional tolerances, but both may require verification. Quality assurance activities by the Engineer will not relieve the Contractor of any responsibilities for the quality control of the accuracy or completeness of the work.

The Department's verification of the positional locations of features, calculation and merging of supplemental terrain data surfaces, and the measurement and calculation for quantity payments will be performed using Department standard software. Both the Contractor and the Department shall utilize the following standards: (1) All terrain data collected for the purpose of being used for or merged with Department provided terrain data for the calculation of pay quantities shall be delivered in a format and correctly display in accordance with the current Departmental CADD Standards. (2) The Department will maintain record copies of electronic data files which will be available to the Contractor using the Department's designated file management system or other method. This will ensure that both parties utilize the same credible data from which to establish locations and measure quantities. The Department will provide all available CADD resource files for use by the Contractor.

The Contractor may choose to introduce an additional new automated survey method or technology which involves a new technique for positioning features, measuring quantities, or verifying constructed locations. The quality and accuracy of this data produced by this method shall be demonstrated to the Engineer, for acceptance, by a comparison of this method to previously accepted techniques over a mutually agreed upon portion of the work. The new technology shall meet or exceed the quality and accuracy results provided by previously accepted techniques, and the Engineer shall make the final determination as to the acceptability of its use based on the resulting performance, cost savings, safety and effectiveness of the operation. Previous uses of this same

method on other contracts or by other contractors are not acceptable evidence of a technology's viability, due to inherent variations in operator's experience levels, data availability, changing field conditions and differing technologies.

### **625-3.03 Right of Way Markers.**

The Contractor shall verify with the Engineer that it has the most current vested Right of Way Acquisition Maps to determine the geospatial positions of all proposed right of way markers. Right of way markers are indicated in the contract for approximate locations and quantities, and shall not be positioned according to the contract information, but rather by the positions shown for the equivalent points on the ROW Maps.

Right of way marker locations shall be determined under the direction of a Land Surveyor from a closed traverse or GPS network which is included in the contract control plan and in accordance with Federal Geographic Data Committee (FGCC) C2-II, Second-Order, Class II (1 part in 20,000) accuracy, ensuring a local accuracy of 0.065 ft as described in the Department's *Land Surveying Standards and Procedures Manual*.

The Contractor shall install right of way markers at the station/offset positions specified on the vested Right of Way Acquisition Maps in accordance with the Standard Sheets to within an absolute positional tolerance of 0.065 ft relative to the primary project control network.

The Land Surveyor shall certify the as-built location of each installed right of way marker on certification forms provided by the Engineer, including contract information, and control line station and offset (proposed and as-built) to the marker. The record location of all right of way markers shall be recorded to the nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy.

Prior to placing the cap on a steel pin right of way marker, the cap shall be filled 2/3 full of silicone sealant and then fastened to the bar by threading or by force fit. During the driving operation for the steel pin right of way marker, the lettering on the cap shall be protected by the use of a metal sleeve or cushion block. The marker shall be driven so that the cap is flush with the ground surface.

### **625-3.04 Permanent Survey Markers.**

The Contractor shall install permanent survey markers in accordance with the standard sheet at locations described in the contract documents and approved by the Engineer prior to installation. The Engineer will provide the Contractor with the sequential numbering required on the permanent survey marker caps in coordination with the Regional Land Surveyor.

When precast permanent survey markers are used, one of the following special excavation and backfill methods shall be used to insure stability. Within undisturbed areas, Method A or Method B may be used. Within disturbed areas, only Method B shall be used.

- **Method A.** The excavation shall allow a minimum clearance of 6 inches around the precast permanent survey marker to be backfilled with concrete meeting the requirements of §501-2.02, Class A. For backfill purposes, small construction mixers will be permitted.
- **Method B.** The excavation shall allow a minimum clearance around the precast unit compatible with the compaction equipment used. The clear area shall be backfilled with Select Granular Fill in accordance with §203-2.06 Select Granular Fill, and compacted in accordance with §203-3.06 Select Granular Fill.

The Contractor shall provide the as-built location of each installed permanent survey marker on certification forms provided by the Engineer, including contract information, as-built NYSPCS values, control line and centerline station and offset to the marker, distance and direction to adjacent markers, the elevation of the marker, and a sketch which shows the relative positions to the control line points, four physical ties to the

markers, and a north arrow. The certification form shall be sealed and signed by a licensed Land Surveyor. The record location of all permanent survey markers shall be recorded to the nearest 0.01 ft and reflect as-built coordinates from a closed traverse or GPS network which is included in the contract control plan and in accordance with FGCC C2-II, Second-Order, Class II (1 part in 20,000) accuracy as described in the Department's "Land Surveying Standards and Procedures Manual."

### **625-3.05 Supplemental Site Survey.**

The Contractor shall perform supplemental site survey work in accordance with §625-3.01 *General* and §625-3.02. *Survey Operations*. The limits of the survey and mapping and the need for property line or right of way determination shall be as described in the Special Note entitled *Supplemental Site Survey Requirements*. Changes to the contract established limits by the Engineer shall be considered changes to the scope of work. The work shall include:

1. The Engineer shall determine what level of detailed information may need to be added to the Contract Control Plan for a supplemental site survey. Significant additional requirements will be considered extra work.
2. For new locations, a minimum of 3 inter-visible horizontal control points and 2 benchmarks shall be set at each site.
3. All survey control and terrain data collection shall be performed in accordance with the standards and procedures required in the Department's *Land Surveying Standards and Procedures Manual*.
4. Survey shall include all readily identifiable surface and subsurface utilities, including, but not limited to drainage, sanitary, water supply, gas, electric and telephone. The Contractor shall contact the appropriate one call center to identify all underground utilities so they can be marked in the field at each site prior to survey.
5. If property or right of way markers are found inside of or within 30 ft of the survey limits, they shall be located and described as part of the survey.
6. For traffic signal intersection work, elevations of above-ground utilities at the poles and at sag points shall be provided for primary and secondary electric lines, telephone lines and cable television lines. Utility poles shall be identified, including pole numbers. The next pole by number, and next manhole or valve. Sign inventory shall include only a type designation (e.g. stop sign, no parking sign, etc.) without MUTCD code, or a brief description of a private sign.
7. For underground utility surveys, the horizontal positions and vertical elevations of all exposed public and private utilities within the described limits shall be located, mapped and appropriately identified by the Contractor according to the utility's identification. Horizontal positions and vertical elevations shall be determined from project control to within 2 inches of its absolute location. Linear utilities shall be located at all bend or angle points, junctions or termini, and at a spacing of no more than 50 feet.
8. Copies of original survey field data, tie diagrams, and control diagrams shall be provided in Department accepted formats.
9. All terrain mapping deliverables (DGN & DTM) shall conform to the requirements included in Chapter 20 and 22 of the Department's *Highway Design Manual*.
10. File naming convention shall conform to standards listed in Appendix 14 of the Department's *Project Development Manual*.

### **625-3.06 GPS Inspection Units.**

The Contractor shall furnish, configure, install, maintain and remove the GPS units, and provide the Engineer and/or their representatives with training on the operation of the GPS units. The Contractor shall ensure all GPS units are fully operational and training has been provided before construction begins.

All projects shall utilize the NYS CORS as the spatial reference datum network from which RTK corrections are derived. The Contractor shall choose which communication technique and devices will be



used which will insure the consistent and reliable delivery of RTK correctional data from the NYS CORS to the GPS units. When geographic location or lack of a reliable communications network prohibits the use of the NYS CORS, the Engineer may approve the use of a Survey Grade GPS Inspection unit as a base station in place of the NYS CORS, which will be paid for separately. The Contractor shall semi-permanently mount the base station in a stable and secure location where it shall not be disturbed by construction activities nor be easily damaged by vandalism and where it shall be capable of providing radio signal coverage over the entire contract area. If the base station cannot broadcast a signal that covers the entire site, the Contractor shall provide adequate repeater radios or other communications. A GPS unit installed as a base station for inspection operations shall only be moved with the approval of the Engineer.

The GPS units shall be maintained and remain in service until either: (a) a maximum of one week after the Engineer requests its removal in writing, or (b) the State relinquishes the Engineer's Field Office. The Contractor shall maintain all GPS units and software in good working condition and shall provide replacement due to breakdown, damage, or theft within 2 work days. The Contractor shall retain ownership of all supplied GPS units at the end of the contract.

#### **A. GPS Training Provisions.**

1. For all GPS units, the Engineer and/or their representatives shall be provided with a minimum of one 8 hour training session for GPS localization/calibration of the contract site.
2. For all Survey Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of two separate 8 hour minimum training sessions on the use and operation of the GPS units during the first year of the contract. One of these two sessions shall occur within one week of delivery of GPS units to the site. The second of the two classes shall occur upon the request of the Engineer. One additional 8 hour minimum training session shall be provided during each additional contract year that the GPS units are in service.
3. For all Mapping Grade GPS units, the Engineer and/or their representatives shall be provided with a minimum of one training session during the first year of the contract, being at least 8 hours in length, and to occur within one week of delivery of GPS units to the site. This training shall be separate from the Survey Grade GPS Unit training.
4. All training shall be performed by a manufacturer-verified trainer who is approved by the Engineer. The training shall occur at the Engineer's Field Office or at a location agreed to by the Engineer.

### **625-4 METHOD OF MEASUREMENT**

**625-4.01 General.** (Vacant)

**625-4.02 Survey Operations.** This work will be measured on a lump sum basis.

**625-4.03 Right of Way Markers.** The quantity to be measured for payment will be the number of right of way markers installed.

**625-4.04 Permanent Survey Markers.** The quantity to be measured for payment will be the number of permanent survey markers installed.

**625-4.05 Supplemental Site Survey.** This work will be measured on a lump sum basis for each site location.

**625-4.06 GPS Inspection Units.** The quantity to be measured for payment will be the number of GPS Inspection units provided.

## 625-5 BASIS OF PAYMENT

### 625-5.01 General. (Vacant)

**625-5.02 Survey Operations.** The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including preparation of the contract control plan. Progress payments will be made in proportion to the amount of work completed.

**625-5.03 Right of Way Markers.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

**625-5.04 Permanent Survey Markers.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after the complete and proper installation of the marker, receipt of the certification form by the Engineer, and after approval of the certification by the Regional Land Surveyor.

**625-5.05 Supplemental Site Survey.** The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work. Payment will be made upon the satisfactory submission of the completed and certified mapping deliverables. Substantive additions to the work limits described in the contract will be considered extra work.

**625-5.06 GPS Inspection Units.** The unit price bid shall include the cost of labor, materials and equipment necessary to satisfactorily complete the work, including the cost of the required training and necessary maintenance.

### *Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
625.01	Survey Operations	Lump Sum
625.03	Concrete Right of Way Markers Type H (High)	Each
625.04	Concrete Right of Way Markers Type L (Low)	Each
625.05	Steel Pin and Cap Right of Way Markers	Each
625.06	Permanent Survey Markers	Each
625.07nnnn	Supplemental Site Survey	Lump Sum
625.11nnnn	Survey Grade GPS Inspection Unit	Each
625.12nnnn	Mapping Grade GPS Inspection Unit	Each

## SECTIONS 626 THRU 628 (VACANT)

## SECTION 629 - PETROLEUM STORAGE TANK CLOSURE

(Last Revised January, 2017)

### 629-1 DESCRIPTION

**629-1.01 General.** This work shall consist of emptying, purging/inerting, cleaning, removing, and disposing of petroleum storage tanks; endpoint sample collection and analysis; and proper documentation of the work in accordance with the contract documents and as directed by the Engineer.

## **629-2 MATERIALS** (Not Specified)

### **629-3 CONSTRUCTION DETAILS**

**629-3.01 General.** All petroleum storage tanks shall be closed in accordance with the requirements of the NYS Department of Environmental Conservation (NYSDEC), as well as local fire and police agencies. NYSDEC shall be notified prior to the initiation of tank closure activities. For instances where tanks that have not been identified during the design process are discovered during construction, NYSDEC shall be notified as soon as possible after discovery of the tank(s). If evidence of a petroleum spill that was not previously reported is discovered during construction, the contractor shall call the NYSDEC Spills Hotline at 1 (800) 457-7362, within two hours of discovering the spill.

Excavation shall be performed in accordance with Section 206 *Trench, Culvert and Structure Excavation*. Segregation and stockpiling of contaminated soils shall be performed in accordance with Section 205 *Contaminated Soil*. If specified in the contract documents, or at the request of the Department in instances where tanks are not discovered until after construction has begun, the Contractor shall provide field organic vapor monitoring in accordance with §205-3.03 *Field Organic Vapor Monitoring* in the following instances: contaminated soil is present; there is a potential for nuisance petroleum odors; or if the work is being performed in close proximity to residences, schools, or other sensitive receptors.

The Contractor shall provide a schedule for tank closure activities to the Engineer a minimum of 35 calendar days prior to commencing work, except for when previously unidentified tanks are discovered during construction and the work will take place in less than 35 calendar days. In such instances, the Contractor shall notify the Engineer immediately upon discovery of the tank(s). The Department will notify appropriate NYSDEC personnel at least 30 calendar days prior to tank closure activities, except for when previously unidentified tanks are discovered as described above. In such instances, the Department will notify NYSDEC as soon as possible after discovery of the tank(s).

**629-3.02 Removal/Disposal of Liquids from Petroleum Storage Tanks.** Before the removal of any tank begins, it shall first be rendered free of product and water. All liquids shall be disposed of in accordance with §107-10 *Managing Surplus Material and Waste*. Product shall be managed with a preference toward recycling or beneficial reuse when such options are available. Liquids shall be transported to the disposal/recycling facility only by appropriately permitted haulers. During the removal operation (including cutting the tank open to remove product, if necessary) the following restrictions shall apply:

1. The work area shall be secured by, at a minimum, erecting a 4 foot construction fence to create an 25 foot controlled access perimeter around the tank pit and posting signs stating “Authorized Personnel Only” or equivalent. This perimeter shall be maintained until the tank has been disposed of and the tank pit has been backfilled.
2. All open-flame and spark producing equipment within the area shall be shut down.
3. All electrical and internal combustion equipment, unless it is designed to be “explosion proof” or “intrinsically safe”, shall be removed from the work area.
4. Only “non-sparking” tools shall be used.
5. Static electricity shall be controlled.
6. Smoking shall be prohibited in the work area.

**629-3.03 Petroleum Storage Tank Closure.** Tank closures shall consist of all of the following components, unless specifically noted in the contract documents.

**A. Project Safety and Health.** The Contractor shall ensure that all personnel directly involved in tank closure activities have been trained in conformance with the requirements of 29 CFR 1910.120 and

1926.65 (referred to hereafter as 1910.120). There shall be at least one person on site who has supervisor training as per 29 CFR 1910.120(E)(4) during all tank closure activities. The Project Safety and Health Plan (PSHP) required by §107-05B shall also meet the requirements of 29 CFR 1910.120 (b) (4).

**B. Tank Atmosphere Monitoring.** The contractor shall use a combustible gas indicator (CGI) or an explosion meter and an oxygen meter to monitor the tank atmosphere.

**C. Tank Purging/Inerting.** The Contractor shall make the tank atmosphere safe by purging the flammable vapors from the confined space to below 5% of the lower explosive limit (LEL) and, unless positive ventilation is used, the oxygen level is below 7%. Care shall be exercised to ensure that purging/inerting is completed before proceeding with tank cleaning and cutting. The Contractor shall purge/inert the tank atmosphere by using one of the following methods:

**1. Dry Ice.** The Contractor shall add dry ice (1.5 lb per 100 gallons of tank capacity) into the tank. The dry ice shall be crushed and distributed evenly over the greatest possible area of the tank interior. As the dry ice vaporizes flammable vapors will flow out of the tank, therefore, the Contractor shall observe all safety precautions regarding flammable vapors.

**2. Carbon Dioxide.** The Contractor shall add carbon dioxide gas directly into the tank to purge flammable vapors. A minimum of one, fully charged, 75 lb cylinder of carbon dioxide gas per 2,000 gallons of tank volume shall be used. Care shall be exercised to prevent buildup of any static charge. The nozzle shall be bonded or grounded and the gas introduced slowly to reduce static.

**3. Nitrogen.** The Contractor shall add nitrogen gas directly into the tank to purge flammable vapors. Vapors within the storage tank must be displaced with an amount of nitrogen gas equal to or greater than the volume of the tank atmosphere. Care shall be exercised to prevent buildup of any static charge. The nozzle shall be bonded or grounded and the gas introduced slowly to reduce static.

**4. Positive Ventilation.** With prior written approval from the Engineer, the Contractor may use positive ventilation to purge flammable vapors from a tank using an air eductor. If performed improperly, this can be a very dangerous procedure and is not recommended for on-site purging of flammable vapors especially in high density urban areas.

**D. Tank Removal.** Regardless of the method selected to purge/inert the tank atmosphere, removal work shall not start until the readings from the CGI or explosion meter indicate that a safe and non-explosive tank atmosphere has been achieved as evidenced by readings less than 5% of the LEL at all elevations within the tank and if dry ice, carbon dioxide, or nitrogen are used to purge/inert the tank, readings from the oxygen meter indicate that an atmosphere of less than 7% oxygen is present throughout the tank. Removal work shall be progressed diligently without interruption until its completion. The CGI or explosion meter shall be used to take subsequent readings continuously as work is progressing. If any reading indicates an atmosphere with greater than 10% of the LEL is present, or the LEL is rising steadily, work shall cease and purging/inerting shall be repeated. Tank-related piping and connecting lines shall either be disconnected and removed or securely capped and plugged.

The tank shall be removed from the tank pit and placed on 6 mil minimum plastic sheeting with the vents aligned at the top of the tank (the 12 o'clock position). The tank shall be blocked or chocked in order to prevent rolling.

Contaminated soil, if present in or around the tank, shall be handled and managed in accordance with provisions found in Section 205 *Contaminated Soil*.

**E. Tank Interior Cleaning and Tank Cutting.** Immediately after the tank has been removed from the ground and a safe atmosphere is confirmed, the tank shall be cut open with non-sparking equipment. Two large holes shall be made in the tank to allow for cross ventilation. The tank shall then be fully ventilated until the CGI or explosion meter indicates an atmosphere with less than 5% of the LEL and an oxygen concentration between 19.5% and 21.5% is present. All remaining sludge and residue shall be removed by vacuuming, non-flammable solvent washing, or sweeping with dry absorbents. The Contractor shall permit only trained and properly equipped personnel to enter the tank. Permit-required confined space entry procedures in accordance with 29 CFR 1910.120 shall be used for all tank entries. All product, product-soaked sorbents, cleaning solvents, and water generated by the operation, shall be transported by a hauler permitted under 6 NYCRR 364 and, disposed of in accordance with the waste disposal regulations of the receiving state.

In instances where there is insufficient work area available to safely perform tank interior cleaning and cutting on-site, the Engineer may permit the Contractor to move the tank to an alternative location for interior cleaning and cutting. Uncleaned tanks shall be transported only by transporters permitted under 6 NYCRR 364. Prior to transporting an uncleaned tank, all holes shall be plugged and the tank shall be placarded according to USDOT regulation 49 CFR 172.500. The tank shall be vented by means of a 1/8 inch hole in one of the plugs. The tank shall be securely fastened to the transporting vehicle, and oriented so that the plug with the hole in it is uppermost on the tank.

**F. Documentation.** Tank closure activities shall be documented both in written format and photographically. The Contractor shall document the number of tanks, tank capacities, tank types (i.e., steel, fiberglass, etc.) and conditions (i.e., sound, corroded but intact, leaking, etc.), products stored in tanks, soil conditions, presence/absence of field indications of soil/groundwater contamination, tank removal, and all subsequent tank closure activities until the tank has been loaded and secured for transportation off-site. The Engineer shall also be provided with copies of any chain-of-custody forms, laboratory reports, and documentation of the final disposition of the tank and any contaminated soil that was removed. When tank closure activities have been completed, the Department will submit a Tank Closure Report which includes all relevant documentation, including laboratory reports and tank disposal documents, to NYSDEC.

**G. Tank Exterior Cleaning and Tank Disposal.** All tanks shall be cleaned of all soil, residue and product clinging to their exterior surfaces prior to being transported off-site. All contaminated soil, product, cleaning solvents, and water generated by the operation, shall be transported by a transporter permitted under 6 NYCRR 364 and, disposed of in accordance with §107-10 *Managing Surplus Material and Waste*. A tank that has been rendered free of product and cleaned is considered scrap, and shall be recycled or disposed of by the Contractor.

**H. Backfilling.** After the completion of endpoint sampling and documentation activities which require the tank pit to remain open, the Contractor shall backfill any resulting holes and trenches with suitable material.

**629-3.04 Endpoint Sample Collection and Analysis.** NYSDEC personnel, if present during tank closure activities, may advise the Engineer that endpoint samples are not required in order to obtain tank closure. If NYSDEC personnel are not on-site during tank closure, or if NYSDEC personnel are on site and suggest that endpoint samples will be required in order to obtain tank closure, endpoint samples shall be collected as follows:

After contaminated soil, if present, is removed to the extent practicable, a person, whose qualifications have been submitted in accordance with §205-3.01 B. 3. *Sampling Plan*, shall collect a total

of five composite samples from the tank pit. A composite sample is defined as a sample composited from individual grab samples collected on an areal or cross sectional basis. Each composite sample shall be made up of equal volumes of grab samples collected in an identical manner. One composite sample shall be collected from each of the side walls at a distance approximately one third up from the bottom of the pit and one composite sample shall be collected from the bottom of the pit. Samples shall be collected into properly labeled laboratory provided glassware, which shall then be placed into re-sealable plastic bags and stored in a cooler with ice. The contractor shall deliver the samples, in accordance with appropriate chain-of-custody procedures and sample hold-times, to a NYS Department of Health Environmental Laboratory Approval Program (ELAP) Certified laboratory for the following analyses:

**A. Confirmed Gasoline Tanks:** Submit samples for analysis of volatile organic compounds (VOCs) by USEPA Method 8260 (STARS list compounds + MTBE).

**B. Fuel Oil/Diesel/Suspect Gasoline Tanks:** Submit samples for analysis of VOCs by USEPA Method 8260 (STARS list compounds + MTBE) and for analysis of polycyclic aromatic hydrocarbons (PAHs), also referred to as base/neutrals (B/N's), by USEPA Method 8270.

**C. Waste Oil Tanks:** Submit samples for analysis of VOCs by USEPA Method 8260 + MTBE, semi-volatile organic compounds (SVOCs) by USEPA Method 8270, RCRA Metals by USEPA Methods 6010 and 7471, and for polychlorinated biphenyls (PCBs) using USEPA Method 8082.

**D. Tanks Containing Other Products:** Submit samples for analyses specified in the contract documents. For previously unidentified tanks containing products other than gasoline, #2 fuel-oil/diesel, or waste oil that are discovered during construction, the Contractor shall contact NYSDEC for the appropriate analytical methods.

The Contractor shall provide the Engineer with a copy of the completed chain-of-custody form before the samples are taken off-site for delivery to the laboratory, and a copy of the laboratory report within 14 calendar days of sample collection.

## 629-4 METHOD OF MEASUREMENT

### 629-4.01 General. (Vacant)

**629-4.02 Removal/Disposal of Liquids from Petroleum Storage Tanks.** The quantity of removed/disposed of liquids to be measured for payment will be in gallons, measured to the nearest whole gallon. The Contractor shall provide disposal receipts from an approved facility that accepts the material to verify the quantity disposed.

**629-4.03 Petroleum Storage Tank Closure.** The quantity of tanks closed to be measured for payment will be the number of tanks within the indicated size range closed.

**629-4.04 Endpoint Sample Collection and Analysis.** The quantity to be measured for payment will be the number of samples collected and analyzed according to the specified methods.

## 629-5 BASIS OF PAYMENT.

**629-5.01 General.** Soil Handling, Field Organic Vapor Monitoring other than within the tank atmosphere, and removing and disposing of contaminated soil, except soil contaminated during the tank removal operations, will be paid for separately.

**629-5.02 Removal/Disposal of Liquids from Petroleum Storage Tanks.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including laboratory analyses required for the proper disposal of the liquids. The maximum amount of payment will be the unit bid price multiplied by the capacity of the tank.

**629-5.03 Petroleum Storage Tank Closure.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, not including excavation and backfill.

Progress payments of 50% of the unit price bid will be paid after the tank removal has been completed, a completed Form HC 629 *Tank Closure Form* and, if endpoint samples were required, a completed chain of custody form showing that the samples were delivered to the laboratory. The remaining percentage will be paid after the Department has received from the Contractor all remaining documentation necessary for the Department to submit a complete Tank Closure Report to NYSDEC, including: invoices confirming the final disposition of: the tank, any liquids removed from the tank, any wastes generated during tank cleaning, and any contaminated soil that was removed; and, if endpoint samples were required, a final laboratory report.

**629-5.04 Endpoint Sample Collection and Analysis.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Payment will be made after all analytical data has been received by the Department, and a Department representative has reviewed the data to verify that it is correct.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
629.01	Removal/Disposal of Liquids from Petroleum Tanks	Gallon
629.02xx	Petroleum Storage Tank Closure (various size ranges)	Each
629.0301	Endpoint Sample Collection and Analysis (Confirmed Gasoline Tanks)	Each
629.0302	Endpoint Sample Collection and Analysis (Fuel Oil/Diesel/Suspect Gasoline)	Each
629.0303	Endpoint Sample Collection and Analysis (Waste Oil Parameters)	Each
629.0304	Endpoint Sample Collection and Analysis (Other Product Parameters)	Each

**NOTE:** xx -see Pay Item Catalog or Proposal for complete description.

**SECTION 630 - BARRICADES**

**630-1 DESCRIPTION.** This work shall consist of furnishing and erecting in accordance with the appropriate standard sheet, permanent type barricades for highway or highway-railroad installations at the locations indicated on the plans or as directed by the Engineer.

**630-2 MATERIALS.** Materials shall meet the requirements of the following subsections of Section 700 - Materials and Manufacturing.

Wood Posts	710-13
Galvanized Steel Barrier Posts	710-14
Corrugated Beam Guide Railing and Median Barrier	710-20
Reflective Sheeting	730-05

**630-2.01 Barricades (All Permanent Types).** Rails shall conform to §710-20 Corrugated Beam Guide Railing and Median Barrier, and to the details indicated on the appropriate standard sheet.

Posts shall be steel W6x15 or wood 6 x 8 inch (nominal) as indicated in the proposal and in accordance with the details shown on the appropriate standard sheet for Highway Barrier and Highway Railroad Barricade. All metal posts shall conform to §710-14 Galvanized Steel Barrier Posts.

**630-3 CONSTRUCTION DETAILS**

**630-3.01 Barricades (All Permanent Types).** Posts shall be set as shown on the plans, the applicable standard sheet, or as directed by the Engineer, and shall be set true to the line and grade and on a firmly tamped base.

Rails shall be erected in such a manner as to produce a smooth appearance, and approximately parallel with the grade of the ground surface. Bolts shall be drawn tight and shall extend 1/4 to 1/2 inch beyond the nuts unless otherwise permitted by the Engineer.

**630-4 METHOD OF MEASUREMENT**

**630-4.01 Barricades (All Permanent Types).** The quantity to be measured for payment under this work will be the number of feet of barricade outside to outside of end posts plus an allowance of 4 feet for each complete terminal assembly including all rails as specified on the plans.

**630-5 BASIS OF PAYMENT**

**630-5.01 Barricades (All Permanent Types).** The unit price bid per foot shall include the cost of all labor, equipment and material necessary to complete the work including inspection and testing information required as well as painting, excavating and backfilling. Any required signs will be paid for separately under the appropriate payment item.

*Payment will be made under:*

Item No.	Item	Pay Unit
630.01	Barricade (Steel Posts)	Foot
630.02	Barricade (Wood Posts)	Foot

**SECTION 631 (VACANT)**

**SECTION 632 (VACANT)**

**SECTION 633 - CONDITIONING EXISTING PAVEMENT PRIOR TO HOT MIX ASPHALT (HMA) OVERLAY**

**633-1 DESCRIPTION.** Cleaning, sealing, and filling joints and cracks in the existing pavement, removal and repair of deteriorated pavement sections, stress-relieving pavement repairs, and cleaning the existing pavement and shoulders prior to the application of a new HMA course.

**633-2 MATERIALS.** Use materials conforming to the requirements of the specifications listed below:

Hot Mix Asphalt True & Leveling	401 and 402
Hot Mix Asphalt Shim	401
Asphalt Filler	702-0700 (Table 702-2, Miscellaneous Asphalt Cements)
Anionic or Cationic Asphalt Emulsion	702
Fine Aggregate	703-01



## 633-3 CONSTRUCTION DETAILS

**633-3.01 Cleaning Existing Pavement and/or Shoulders.** Clean existing pavement and shoulder surfaces to be overlaid, including ruts and depressions, by the use of mechanical sweepers, hand brooms, or other means until the surfaces are free of all material which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be approved by the Engineer prior to use.

Remove all debris from the pavement and shoulders surfaces and dispose of in an appropriate manner. Keep the pavement and shoulders clean until the overlay operations are completed. Cleaning of shoulders is required only when the shoulder surface is constructed of Portland Cement Concrete (PCC), Hot Mix Asphalt (HMA) or a surface treatment thereon.

**633-3.02 Cleaning, Sealing and/or Filling Joints and Cracks.** If the existing pavement requires stress relieving repairs, complete these repairs in accordance with §633-3.05, Stress Relieving Pavement Repairs, prior to joint and crack repair work.

Use a compressed air stream of at least 80 psi gage measured at the source, to clean all unsealed and inadequately sealed joints and cracks. Clean all joints and cracks in the pavement of all dirt and loose material to a depth equal to a minimum of twice the crack or joint width, by holding the cleaning jet 1 inch above the pavement surface. Old joint and crack sealer remaining after such cleaning operation need not be removed. Keep the joint and cracks clean until the sealing, filling, and paving operations are completed.

Joints and cracks less than 1/4 inch are not required to be cleaned or sealed. Seal joints and cracks in the existing pavement from 1/4 to 1 inch wide with an asphalt filler. To ensure that space will be available for expansion of the asphalt filler when the HMA is paved over the joint or crack, do not fill the joint or crack completely to the surface. Blot with fine aggregate, if required, to prevent tracking the bituminous material over the pavement surface.

Fill joints and cracks greater than 1 inch wide with HMA Shim or an approved cold, plant-mixed stockpile patching material.

**633-3.03 Removal and Repair of Deteriorated HMA Pavement Sections.** Remove and dispose of deteriorated HMA pavements to sound material, such that all excavated sides are vertical. Use a chipping hammer meeting the requirements of §580-3.02, Removal of Structural Concrete, a milling machine equipped with a means to suppress airborne particles, or by other appropriate means. If a chipping hammer is used, first sawcut the pavement around the perimeter of the designated repair area to the anticipated repair depth.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas only when the ambient temperature is 45°F or greater. The minimum HMA placement temperature shall be 250°F.

If the total depth of the patch is greater than 3 inches, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. When placing HMA in multiple lifts, thoroughly compact the lower lifts with a mechanical tamper. For the top lift, thoroughly compact with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 1/4 inch above the existing surface.

**633-3.04 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections.** Remove loose, broken, or spalled PCC pavements to sound material, but not exceeding a depth of 3 inches. Use a chipping hammer meeting the requirements of §580-3.02, Removal of Structural Concrete, a milling machine equipped with a means to suppress airborne particles, or by other appropriate means. If a chipping hammer is used, first sawcut the pavement around the perimeter of the designated repair area to

the anticipated repair depth not to exceed 3 inches. Dispose of all the removed PCC material in an appropriate manner.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas only when the ambient temperature is 45°F or greater. The minimum HMA placement temperature shall be 250°F.

If the total depth of the patch is greater than 3 inches, compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. When placing HMA in multiple lifts, thoroughly compact the lower lifts with a mechanical tamper. For the top lift, thoroughly compact with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 1/4 inch above the existing surface.

**633-3.05 Stress Relieving Pavement Repairs.** Unless indicated otherwise in the contract documents, the pressure relief joint shall be a minimum of 15 feet longitudinally and the full width of the pavement, including the curb, and gutter, if any. If an existing transverse joint is within the pressure relief joint repair, remove the existing transverse joint by a minimum of 12 inches. Saw cut the transverse lines of the designated repair area full depth to produce a neat cut. Remove the PCC pavements with minimum disturbance to the subbase. Dispose of all the removed PCC material in an appropriate manner.

Level and recompact the subbase, prior to the placement of the HMA.

Clean and dry all surfaces exposed from removal operation such that they are clean and free of dust and debris. Uniformly apply asphalt emulsion to these surfaces and place the HMA in the repair areas only when the ambient temperature is 45°F or greater. The minimum HMA placement temperature shall be 250°F.

Compact the HMA in multiple lifts of approximately equal thickness with a maximum lift of 3 inches. Thoroughly compact each lift with a roller meeting the requirements of §402-3.04, Rollers, or a small vibratory roller approved by the Engineer. Slightly overfill the patch with HMA such that the resulting patch is dense, smooth, and no more than 1/4 inch above the existing surface.

#### **633-4 METHOD OF MEASUREMENT**

**633-4.01 Cleaning Existing Pavement and/or Shoulders.** The quantity measured will be the number of square yards of existing pavement and/or shoulder surfaces cleaned.

**633-4.02 Cleaning, Sealing, and/or Filling Cracks.** The quantity measured will be on a lump-sum basis for work satisfactorily completed.

**633- 4.03 Cleaning, Sealing, and/or Filling Joints.** The quantity measured will be on a linear feet basis for work satisfactorily completed.

**633-4.04 Removal and Repair of Deteriorated HMA Pavement Sections.** The quantity measured will be the number of square yards of existing pavement surface removed and repaired.

**633-4.05 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections.** The quantity measured will be the number of square yards of existing pavement surface removed and repaired.

**633-4.06 Stress Relieving Pavement Repairs.** The quantity measured will be the number of square yards of existing pavement surface removed and repaired.

#### **633-5 BASIS OF PAYMENT**

**633-5.01 Cleaning Existing Pavement and/or Shoulders.** The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

**633-5.02 Cleaning, Sealing, and/or Filling Cracks.** The lump sum price bid for this item shall include the cost of all labor, materials, and equipment necessary to complete the work.

**633-5.03 Cleaning, Sealing and/or Filling Joints.** The unit price bid for this item shall include the cost of all labor, materials, and equipment necessary to complete the work.

**633-5.04 Removal and Repair of Deteriorated HMA Pavement Sections.** The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

**633-5.05 Removal and Repair of Loose, Broken, or Spalled PCC Pavement Sections.** The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

**633-5.06 Stress Relieving Pavement Repairs.** The unit price bid for this work shall include the cost of all labor, materials, and equipment necessary to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
633.11	Cleaning Existing Pavement and/or Shoulder	Square Yards
633.12	Cleaning, Sealing and/or Filling Cracks	Lump Sum
633.13	Cleaning, Sealing and/or Filling Joints	Linear Foot
633.14	Removal and Repair of Deteriorated HMA Pavement	Square Yards
633.15	Removal and Repair of Loose, Broken, or Spalled PCC Pavement	Square Yards
633.16	Stress Relieving Pavement Repairs	Square Yards

**SECTION 634 (VACANT)**

**SECTION 635 - CLEANING AND PREPARATION OF PAVEMENT SURFACES FOR PAVEMENT MARKINGS**

**635-1 DESCRIPTION.** This work shall consist of cleaning and preparing portland cement and bituminous pavement surfaces for the application of reflectorized pavement marking materials. Examples of pavement markings requiring this item include, but are not limited to, reflectorized thermoplastic, preformed, and epoxy type marking materials.

**635-2 MATERIALS.** Materials and equipment for cleaning and preparing pavement surfaces may be selected by the Contractor, except that they will be approved by the Engineer and shall conform to all applicable Local, State or Federal law, regulation or codes.

**635-3 CONSTRUCTION DETAILS**

**635-3.01 General.** The work required to clean and prepare pavement surfaces shall be performed in accordance with these specifications, the contract documents and to the satisfaction of the Engineer. Before any work is begun, a schedule of operations shall be submitted for the approval of the Engineer. When the work is conducted under traffic, the Contractor shall supply all necessary flags, markers, signs, and other devices to maintain and protect traffic.

Whenever grinding, waterblasting, dry sandblasting or other operations are performed, the work shall be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect the motorist. When these operations are completed the pavement surface shall first be power broomed and then blown off with compressed air to remove residue and debris resulting from the cleaning work. All such debris that remains on the roadway, including broken parts from cleaning equipment, shall be removed and disposed of in a manner satisfactory to the Engineer.

The Contractor shall conduct removal and cleaning work in such a manner as to minimize airborne dust, and similar debris so as to prevent a hazard to motor vehicle operation or nuisance to property.

Care shall be taken on bituminous and portland cement concrete surfaces when performing removal and cleaning work to prevent damage to transverse and longitudinal joint sealers.

Unless otherwise specified in the contract documents the area(s) and quantity of cleaning work will be determined by the Engineer at the job site when the contract is in progress. In addition the Engineer will have the authority of increasing the work area as the project continues.

**635-3.02 Limits of Work.** Cleaning and surface preparation work shall be confined to the surface area specified for the application of pavement marking materials; or the surface area of existing pavement markings that are specified for removal on the plans, or as directed by the Engineer.

Surface preparation work includes cleaning for lines or cleaning for letters and symbols. Lines will be meant to include: broken line; dotted line; channelizing line; barrier lines; stop lines; crosswalk line and crossbars.

When lines are cleaned, the area of preparation will be the width of the new pavement marking, or existing line, plus 1 inch on each side. When letters and symbols are cleaned the area of preparation will be sufficiently large to accommodate the new marking, or to remove the existing marking.

**635-3.03 Cleaning Concrete Curing Compounds.** On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed.

The extent of the blasting work shall be to clean and prepare the concrete surface such that:

- A. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
- B. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
- C. All remaining curing compound is intact; all loose and flaking material is removed.
- D. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

**635-3.04 Cleaning Existing Pavement Markings.** Existing pavement markings shall be cleaned for the purpose of:

- A. Preparing the pavement surface for the application of new pavement markings in the same location as the existing markings.
- B. To remove existing markings that are in good condition which, if allowed to remain, will interfere with or otherwise conflict with newly applied marking patterns.

It shall be understood that in this context cleaning means the removal of an existing marking. It is not intended that all deteriorated existing pavement markings be removed. Example: If a new marking is applied to an unmarked "gap" in a broken line and the existing broken line pattern is worn or deteriorated, as determined by the Engineer, to the extent that it is not misleading or confusing to the motorist, the existing markings do not require removal.

Pavement markings shall be cleaned to the extent that 95% to 100% of the existing marking is removed. Removal operations shall be conducted in such a manner that no more than moderate color and/or surface texture change results on the surrounding pavement surface. When waterblasting is performed, pavement markings shall be applied no sooner than 24 hours after the blasting has been completed. Waterblasting shall not be allowed for cleaning markings requiring replacement within the same day as removal as specified under §635-3.05.

The determination of acceptable removal will be made by judgement of the Engineer and will be guided by the Department's pictorial standards of acceptable marking removal. Pictorial standards are available from the Materials Bureau.

**635-3.05 Replacement of Pavement Markings.** The Contractor shall not remove existing pavement markings and leave the highway unmarked overnight.

**635-4 METHOD OF MEASUREMENT.** Surface cleaning and preparation of pavement surfaces for lines will be measured in feet along the centerline of the prepared surface and will be based on a nominal 4 inches wide line. Measurement for cleaning surfaces for line widths greater than the nominal 4 inches will be made by the following method:

$$\frac{\textit{Nominal Existing Width of Line (inches)} \times \textit{Length (feet)}}{4 \textit{ (inches)}}$$

No payment will be made for the additional 1 inch of cleaning on each side of the line required by §635-3.02.

No payment will be made for cleaning the number of feet of unmarked gaps between broken or dotted line segments.

Cleaning and preparation of letters and symbols on pavement surfaces will be measured by each unit cleaned. A unit will consist of one letter or one symbol. Example: "STOP" would be measured as four units.

The Engineer will adjust the quantities of these items as required to meet field conditions. This may result in substantial increases or decreases of the proposal quantities.

**635-5 BASIS OF PAYMENT.** The accepted quantities of cleaned pavement surface will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost of maintaining and protecting traffic during the cleaning work will be included in the price bid. No payment will be made under this item for the removal of pavement markings required under §635-3.05.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
635.0103	Cleaning and Preparation of Pavement Surfaces-Lines	Feet
635.0203	Cleaning and Preparation of Pavement Surfaces-Letters	Each
635.0303	Cleaning and Preparation of Pavement Surfaces-Symbols	Each

**SECTION 636 (VACANT)**

**SECTION 637 - ENGINEER'S FIELD OFFICE, LABORATORY AND EQUIPMENT**  
(Last Revised January, 2022)

**637-1 DESCRIPTION.** This work shall consist of providing, furnishing and maintaining an Engineer's Field Office and a Field Laboratory in good working condition and appearance for the exclusive use of,

and occupancy by the inspection staff. The buildings shall be habitable environments, readily accessible to the public and free of any recognizable health or safety hazards. The work shall also consist of providing and maintaining equipment for use by the inspection staff.

**637-1.01 Engineer's Field Office.** This work shall consist of providing for the Engineer's use a building, or a portion thereof, or a modular trailer of a specified type erected at a location approved by the Engineer.

**637-1.02 Field Laboratory.** This work shall consist of providing a Field Laboratory for soils and materials testing at a location approved by the Engineer.

**637-1.03 Concrete Cylinder Curing Box.** This work shall consist of providing a concrete cylinder curing box.

**637-1.04 Rain Gauge.** This work shall consist of providing and maintaining a wireless rain gauge system.

**637-1.05 Inspection Boat.** This work shall consist of providing and maintaining a motorized boat for exclusive use by the Engineer and the Inspection Staff.

**637-1.06 Office Technology Supplies.** This work shall consist of providing technology-related materials and supplies for use by the inspection staff.

**637-1.07 Construction Testing Supplies - Consumables.** This work shall consist of providing consumable testing supplies to be used by inspection staff.

**637-1.08 Partnering Workshop.** This work shall consist of a partnering workshop coordinated and facilitated by an independent facilitator. The Department and the Contractor will share the cost of the partnering workshop equally.

## **637-2 MATERIALS.**

**637-2.01 Engineer's Field Office.** The Engineer's Field Office shall be within a secured, weatherproof building or mobile trailer. If two or more mobile trailer units are provided, they shall be joined with weatherproof connections. Mobile trailers shall be in new or like new condition. The Contractor may furnish equivalent facilities in an existing building, provided that the building is located to provide convenient service. The Contractor shall supply the Engineer with a copy of the Certificate of Occupancy for the existing building.

The Engineer's Field Office shall be in accordance with the requirements of the New York State Uniform Fire Prevention and Building Code, 19 NYCRR, and any applicable local codes.

The Engineer's Field Office shall be in a location with access to high speed broadband (non-satellite) Internet service.

The electrical system shall be able to continuously operate all equipment and be provided with adequate receptacles. To accommodate computer equipment, the field office shall be provided with a dedicated 20 amp electrical service and a vacant floor-to-ceiling area with a 3 foot x 3 foot footprint along a wall for the installation of a computer hardware rack/cabinet. Electric light shall be provided by non glare-type luminaries to provide a minimum illumination level of 100 foot-candles at desk-height level. An ambient air temperature of 70°F ±5°F shall be maintained.

Fire extinguishers and smoke and carbon monoxide detectors shall be provided and installed.

The Engineer's Field Office shall be partitioned to provide separate rooms, defined as either "small" or "large", with adjoining doors. Table 637-1 below contains the minimum area requirements for each of the office types.

<b>TABLE 637-1 ENGINEER'S FIELD OFFICE AREA REQUIREMENTS</b>					
<b>Physical Requirement</b>	<b>Engineer's Field Office Type</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Min. total floor area (sf)	530	860	1300	2500	2700
Min. number of small rooms	2	3	2	3	6
Min. floor area of small rooms (sf)	100	100	120	150	175
Min. number of large rooms	1	1	2	2	2

**A. Potable Water.** From a local municipal water supply, certified well or bottled with a heating/refrigerator unit to provide hot and cold water. An exterior frost-free hose bib shall be provided in a location adjacent to the Engineer's Field Office. The hose bib need not be installed on a potable water line, and if the water in the line is not potable, it shall be clearly marked as such.

**B. Restroom.** A separately enclosed room, lockable from the inside, that is properly ventilated and in compliance with applicable sanitary codes. The Contractor shall provide all lavatory amenities, necessary paper and soap products, hot and cold running water and a toilet. The toilet shall be flush-type where sanitary facilities are available, and a type approved by the Engineer prior to installation where sanitary facilities are not available. The minimum required number of restrooms to be provided is specified in Table 637-2.

**C. Parking Area.** The Contractor shall provide and/or construct paved or hard surfaced (gravel or bankrun material) secure parking area with dedicated parking spaces adjacent to the Engineer's Field Office. Each parking space shall be 9 feet by 18 feet, and the minimum required number of spaces to be provided is specified in Table 637-2.

**D. Field Office Signs.** The sign panel material shall be aluminum, fiberglass, plywood or lightweight plastic. The sign sheeting shall be ASTM Type III. The sign panel shall be 36 inches high by 48 inches wide with white legend on green background with the phrases as positioned and described below. If erected at a location where the sign might be struck by an errant vehicle, the sign support shall be a breakaway type.

The letters in the phrase "FIELD OFFICE" shall be 6 inches C series with the top of the letters 6 inches below the top of the panel. The letters in the phrase "ENGINEER-IN-CHARGE" shall be 6 inches B series with the top of the letters 18 inches below the top of the panel. The letters in the phrase "N.Y.S. DEPT. OF TRANSPORTATION" shall be 1 1/2 inches E series with the top of the letters 30 inches below the top of the panel. All phrases shall be centered horizontally on the panel.

If the Engineer's Field Office is not located within or adjacent to the contract limits, two additional signs shall be displayed conspicuously within the contract limits. The signs shall be similar to the above description, except that they shall be 48 inches high by 64 inches wide and have an additional bottom line of text containing the street address of the Engineer's Field Office. The letters in the street address shall be 6 inches B series with the top of the letters 36 inches below the top of the panel and centered horizontally on the panel.

**E. Mailbox.** Standard mailbox (with post if necessary) or post office box meeting the requirements of the U.S. Postal Service.

**F. Telephone and Answering System.** A separate telephone and answering system for the exclusive use of the inspection staff. The minimum required number of telephone voice lines to be provided is specified in Table 637-2. The telephone and answering system shall provide the ability to

answer all voice lines from each voice line, transfer calls to all voice lines and be equipped with a single, dedicated answering system.

A minimum of one telephone shall be cordless and a minimum of one telephone shall be equipped with speaker and conference call capability. The remaining telephones, at least one per required voice line, shall be extension telephones with minimum 25 foot long cords. The answering system shall be capable of recording outgoing messages up to 60 seconds long and receiving a minimum of 40 incoming messages of 60 seconds duration. The system must include automated voice marking of time and day of each message received and provide a message mark so that new messages may be played back without erasing old messages. The system shall include remote programming of playback, backspace, and outgoing message re-record and allow for the retrieval of messages without a remote control unit.

**G. Paper Shredder.** Automatic start, heavy duty cross-cut paper shredder. The shredder shall be able to receive 8 1/2 inches wide paper and shred a minimum of 15 sheets simultaneously along with CDs and staples.

**H. Pencil Sharpener.** Manual or electric pencil sharpener, minimum 1 per room.

**I. Interior Bulletin Board.** An installed, wall-mounted 4 foot x 6 foot bulletin board made of cork or similar material in a large room, and one 2 foot x 4 foot wall mounted bulletin board installed per room.

**J. Dry Erase Board.** Installed, wall-mounted 2 foot x 4 foot dry erase boards, minimum one per room.

**K. Storage Locker.** Metal or wood storage locker with shelves, a tumbler lock and 2 keys for the storage of survey, GPS and testing equipment. The total locker space footprint provided shall be a minimum of 9 square feet with a minimum height of 6 feet.

**L. Fire Resistant Cabinet.** Fire resistant, legal size filing cabinet with locks and 2 keys each, meeting the requirements of ANSI/UL Standard 72 for Insulated Filing Devices, Class 350-1 hour. Each office shall be provided with two 2-drawer cabinets, and the required number of additional 4-drawer cabinets as specified in Table 637-2.

**M. Bookcase.** Self-standing, 3-shelf metal or wood bookcase, approximately 4 feet high, 4 feet wide and 1 foot deep. The minimum required number of bookcases to be provided is specified in Table 637-2.

**N. Wastebasket.** Minimum 7 gallon wastebasket, minimum one per desk.

**O. Refrigerator.** Electric, top-freezer type providing a minimum storage space of 15 cubic feet for Engineer's Field Office Types 1 and 2, and a minimum storage space of 21 cubic feet for Types 3, 4 and 5.

**P. Kitchenette.** To include a minimum 1 cubic foot, 1,300 watt microwave oven, a sink with hot and cold running water with minimum dimensions of 15 inch x 15 inch x 6 inch deep, usable counter space with minimum dimensions of 5 feet long x 2 feet deep and cabinet space with minimum dimensions of 5 feet long x 1 1/2 feet deep x 2 1/2 feet high. If the water in the sink is not potable, it shall be clearly marked as such.



**Q. Stove.** Electric, propane or bottle gas stove with a minimum of two burners adequate for rapid drying of soil samples, including fuel or electrical supply. A stove is required when a separate Field Laboratory is not included.

**R. First Aid Kit.** A Type III kit in accordance with ANSI Z308.1 Minimum Requirements for Workplace First Aid Kits. The minimum number of first aid kits to be provided is specified in Table 637-2.

**S. Thermometer.** A minimum-maximum thermometer displaying in degrees Fahrenheit and mounted with an external probe to give the temperature both indoors and outdoors.

**T. Coat Rack.** A metal or wood coat rack or closet capable of holding at least 4 coats. The minimum required number of coat racks to be provided is specified in Table 637-2. A single coat rack may be provided as long as it holds the minimum number of coats as per Table 637-2.

**U. Office Desk and Chair.** Fully assembled freestanding office desks and chairs. Each desk shall have a 5 feet long by 2 1/2 feet wide work surface and a height of 30 inches, at least 2 lockable drawers and include an adjustable shelf approximately 1 foot wide and no less than 2 1/2 feet long. Each desk shall also be provided with an adjustable chair with arms, 5 legs with casters and be adjustable from approximately 16 inches to 24 inches in height. Each desk shall have a dedicated electrical outlet receptacle. The required number of office desks and chairs to be provided is specified in Table 637-2.

**V. Office/Conference Table.** Commercial-grade rectangular table with weather/spill resistant top a minimum of 8 feet long by 2 1/2 feet wide by 30 inches high. The minimum required number of office/conference tables to be provided is specified in Table 637-2.

**W. Folding Chair.** Commercial-grade, folding steel chair with approximate overall dimensions of 30 inches high by 19 inches wide by 21 inches deep. The minimum required number of folding chairs to be provided is specified in Table 637-2.

<b>TABLE 637-2 ENGINEER'S FIELD OFFICE FURNISHING REQUIREMENTS</b>					
<b>Furnishing Description</b>	<b>Required Number per Engineer's Field Office Type</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Restrooms	1	1	2	2	3
Parking spaces	6	8	12	18	22
Telephone voice lines	2	3	3	4	4
Fire resistant cabinets (4-drawer)	2	3	4	6	8
Bookcases	5	7	10	12	16
First aid kits	1	1	1	2	2
Coat racks	1	2	3	4	5
Office desks and chairs	4	8	12	18	22
Office/conference tables	2	2	3	4	5
Folding chairs	4	6	8	10	15

**637-2.02 Field Laboratory.** The Field Laboratory shall be a secured, weatherproof room, building or mobile structure not less than 100 square foot floor area in size. The floor covering shall be linoleum, tile or other serviceable finish. A local exhaust system shall be provided. An ambient air temperature of

70°F ±10°F shall be maintained. The Contractor may furnish equivalent facilities in an existing building, provided that the building is located to provide convenient service. The Contractor shall supply the Engineer with a copy of the Certificate of Occupancy for the existing building.

The Field Laboratory shall be in accordance with the requirements of the New York State Uniform Fire Prevention and Building Code, 19 NYCRR, and any applicable local codes.

The electrical system shall be able to continuously operate all equipment and be provided with adequate receptacles. Where an electric hotplate or stove is provided, service shall be increased over 20 amperes by an amount equal to the rating of the device provided.

The Field Laboratory shall be sufficiently anchored to prevent damage from vibration caused by the laboratory equipment.

Fire extinguishers and smoke and carbon monoxide detectors shall be provided and installed.

**A. Potable Water.** From an existing system or from an external 55 gallon (minimum) gravity-feed storage tank connected to the sink faucet and refilled as necessary.

**B. Sink.** A sink at least 36 inches long by 24 inches wide by 18 inches deep, equipped with water faucet and drain line.

**C. Counter.** A work counter next to sink at least 24 inches long by 24 inches wide.

**D. Cabinet.** A storage cabinet or locker at least 2 feet square by 6 feet high, equipped with at least 4 shelves, a lock and 2 keys.

**E. Table.** A heavy duty work table not less than 8 feet long by 2 1/2 feet wide by 3 feet high.

**F. Pedestal.** A heavy wooden block for soil compaction tests, nominally 10 inches square by 12 inches high.

**G. Stove.** As specified in §637-2.01U.

**H. Office Desk and Chair.** As specified in §637-2.01Y.

**637-2.03 Concrete Cylinder Curing Box.** The concrete cylinder curing box shall be constructed of non-corroding materials. A moisture proof seal shall be provided between the lid and body of the box. Provision for automatic control of lime-water temperature to 72°F ±5°F shall be made when the box is located in an uncontrolled environment. A bimetallic thermometer shall be inserted with its sensing element in the storage water. The thermometer shall be capable of being read from the outside without opening the box. The thermometer shall have minimum gradations of 1°F and shall be protected from damage. Electric utility connections shall be made in a lockable switch box securely attached to the outside of the curing box.

The water in a storage tank shall be saturated with calcium hydroxide (lime) to prevent leaching of calcium hydroxide from the specimens. At a minimum, the water in the tank shall be thoroughly stirred every month. Tanks shall be cleaned and refilled with water containing 3 g/L of calcium hydroxide at intervals not to exceed 24 months.

A rustproof wire or metal rack shall be set above the bottom of the box to support cylinders in an upright position. The rack and all temperature control elements shall be positioned to allow free circulation of lime-water around the cylinders. A combination hose connection and drain shall be provided at the lower front edge of the box so that it may be drained or lime-water may be circulated. A drain shall also be provided on the box in such a position that when open will drain water to within 1 inch over the top of the cylinders. All areas of the box shall be easily drained and accessible for cleaning.

The concrete cylinder curing box shall be capable of maintaining the required lime-water temperature through an ambient air temperature range of -10°F to +100°F. The box shall be capable of holding a

minimum of nineteen (19) 6 inch x 12 inch cylinders. When filled with lime water, the box shall not leak enough so that the cylinders are exposed.

**637-2.04 Rain Gauge.** The wireless rain gauge system shall meet the requirements below. All necessary mounting materials and hardware, operating manuals and other pertinent media for the components shall be provided.

- Wireless remote transmission from outdoor weatherproof rainfall sensor to indoor display unit
- Self-emptying tipping bucket
- Display daily rainfall information and at least 9 day historical rainfall records
- Two sets of rechargeable batteries for each component and charging unit
- No computer software shall be necessary for rain gauge operation or rainfall data storage/viewing

**637-2.05 Inspection Boat.** The boat provided shall comply with the following minimum requirements:

- All required capacity, maximum horsepower, and identification plates shall be affixed in the manner required by Coast Guard regulations.
- The motor's horsepower shall meet the rated requirements of the boat and be equipped with a forward, neutral, and reverse. The power train shall be equipped with an interlock so that the engine may not be started in gear. U.S. Coast Guard-approved fuel tanks shall be provided.
- All equipment required by Coast Guard regulations shall be provided for the boat. The equipment shall include, but not be limited to, the following:
  - Class B-1 fire extinguisher
  - Life jackets for all persons aboard
  - One anchor, Danforth-type or Navy stockless, suitable for the specified boat
  - Bailing device
  - Power operated whistle or horn
  - Visual distress signals
  - Means for accessing work sites not accessible from land from the water (piers, floating equipment, etc.)
- Registration, licenses, and other legal requirements for boat operation shall be obtained by the Contractor and kept current by the Contractor for the length of time the boat is in operation.
- Dockage facilities shall be maintained by the Contractor and shall be constructed (if necessary) so that easy access to the boat is provided at all times under all tidal conditions.
- The Contractor shall maintain the boat in good, clean condition at all times as required. Fuel tanks shall be maintained full at all times.

***A. Inspection Boat – Type A***

- Boat lengths up to and including 18 feet
- The boat will be operated by an appropriately trained and certified member of the inspection staff.

***B. Inspection Boat – Type B***

- Boat lengths in excess of 18 feet
- An appropriately trained, certified and licensed operator shall be provided.

**637-2.06 Office Technology Supplies.** Materials as specified in the bid documents or by the Engineer.

**637-2.07 Construction Testing Supplies – Consumables.** Consumable testing materials as specified by the Engineer.

**637-2.08 Partnering Workshop.** None specified.

**637-3 CONSTRUCTION DETAILS.** The equipment, with the exception of the office technology supplies, shall be maintained by, and remain the property of, the Contractor.

**637-3.01 Engineer's Field Office.** The Contractor shall be responsible, until use and occupancy is relinquished by the State, for any and all damage, direct or indirect, of whatever nature, occurring to the property of the State and property of the inspection staff which is kept in the Engineer's Field Office. The Engineer will provide the Contractor with a detailed list of items kept in the office, with corresponding dollar values, and will provide the Contractor with updates when something on the list changes. Non-State-owned property shall only be those items used in the performance of contract-related work activities. Such property shall be replaced within 30 days of the reported damages and would include any loss caused by, but not limited to, fire, theft, vandalism or malicious mischief. The Contractor shall not be responsible for items kept in the Engineer's Field Office that are not on this list.

The Contractor shall install the Engineer's Field Office sign at a location approved by the Engineer. If the Engineer's Field Office is not located within or adjacent to the contract limits, two (2) additional signs shall be displayed conspicuously within the contract limits in locations directed by the Engineer.

The Engineer's Field Office shall be fully equipped and made available for use and occupancy by the inspection staff prior to the start of any contract work, and shall be made available after contract final acceptance as directed in writing by the Regional Construction Engineer.

All furniture and equipment shall be fully assembled, operational, clean and serviceable. The Engineer's Field Office shall be cleaned weekly or more often if required, and the timing of the cleaning operations shall be coordinated with the Engineer. The Contractor shall remove and dispose of all rubbish generated in the office and shall keep the office free from pests. The Contractor shall remove snow from all areas subject to vehicular circulation and parking.

After completion, all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location and the areas cleaned, loamed and restored as required.

**637-3.02 Field Laboratory.** The Contractor shall be responsible for any and all damage, direct or indirect, of whatever nature, occurring to the property of the State which is kept in the Field Laboratory. The Engineer will provide the Contractor with a detailed list of items kept in the laboratory, with corresponding dollar values, and will provide the Contractor with updates when something on the list changes. Non-State-owned property shall only be those items used in the performance of contract-related work activities. Such property shall be replaced within 30 days of the reported damages and would include any loss caused by, but not limited to, fire, theft, vandalism or malicious mischief. The Contractor shall not be responsible for items kept in the Field Laboratory that are not on this list.

The Field Laboratory shall be fully equipped and made available for use and occupancy by the inspection staff prior to the start of any contract work. Such use and occupancy shall be made available after contract final acceptance as directed in writing by the Regional Construction Engineer.

All furniture and equipment shall be fully assembled, operational, clean and serviceable. The Field Laboratory shall be cleaned weekly or more often if required, and the timing of the cleaning operations shall be coordinated with the Engineer. The Contractor shall remove and dispose of all rubbish generated in the laboratory and shall keep the laboratory free from pests.

After completion, all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location, the areas cleaned, loamed and restored as required.

**637-3.03 Concrete Cylinder Curing Box.** Prior to the placement of any structural concrete, the Contractor shall furnish the Engineer a concrete cylinder curing box and 2 locks with 2 keys for each lock. The locks shall fit each securing latch of the curing box. This concrete cylinder curing box shall remain exclusively available to the Engineer at a location approved by the Engineer. The Contractor shall provide and maintain all necessary utility connections to operate the curing box.

**637-3.04 Rain Gauge.** The Contractor shall provide, install and maintain the wireless rain gauge system in accordance with the manufacturer's instructions in a location approved by the Engineer. The Contractor shall make the system fully operational in a timely manner, at a minimum, prior to any soil disturbance at the site. The Contractor shall provide replacement due to breakdown, damage, loss, or theft within 24 hours of notification.

**637-3.05 Inspection Boat.** The Contractor shall furnish the boat (and operator for Type B Inspection Boats) within 5 work days after written notification by the Engineer, and the boat (and operator for Type B Inspection Boats) shall, thereafter, be available at all times to the Engineer and other personnel authorized by the Engineer.

**637-3.06 Office Technology Supplies.** The Contractor shall provide office technology-related supplies for the exclusive use of Department personnel and their authorized representatives. The supplies shall be provided within 2 work days of the Engineer's request unless the Engineer agrees to a longer delivery time. The Department shall retain ownership of the technology-related materials and supplies.

**637-3.07 Construction Testing Supplies - Consumables.** The Contractor shall provide consumable testing materials for the exclusive use of Department personnel and their authorized representatives. The supplies shall be provided within 5 work days of the Engineer's request, unless the Engineer agrees to a longer delivery time. The Department shall retain ownership of the consumable testing materials, both materials used and those materials unused for which the Contractor has been paid, at the completion of the contract.

**637-3.08 Partnering Workshop.** The Contractor and the Regional Construction Engineer will jointly select a facilitator and a location for the workshop. A list of potential facilitators is available from the Department. The facilitator shall present a one to two day Partnering Workshop for this contract between the time of award and the start of work. For long duration, multi-year projects, a subsequent follow-up workshop may be convened, with the agreement of the Contractor and the Regional Construction Engineer, at an appropriate point during the progression of the work. The associated costs for this subsequent workshop will be reimbursed under this item.

## **637-4 METHOD OF MEASUREMENT**

**637-4.01 Engineer's Field Office.** The Engineer's Field Office will be measured for payment as the number of months satisfactorily provided, measured to the nearest 0.25 months.

**637-4.02 Field Laboratory.** The Field Laboratory will be measured for payment as the number of units satisfactorily provided.

**637-4.03 Concrete Cylinder Curing Box.** The concrete cylinder curing boxes will be measured for payment as the number of units furnished and installed.

**637-4.04 Rain Gauge.** The rain gauge will be measured for payment as the number of units furnished and installed.

**637-4.05 Inspection Boat.** The inspection boat will be measured for payment on a monthly basis, measured to the nearest 0.25 months.

**637-4.06 Office Technology Supplies.** Office technology supplies will be measured for payment on a fixed price Dollars-Cents pay unit basis.

**637-4.07 Construction Testing Supplies – Consumables.** Construction testing supplies will be measured for payment on a fixed price Dollars-Cents pay unit basis.

**637-4.08 Partnering Workshop.** The Partnering Workshop will be measured for payment on a Dollars-Cents pay unit basis.

**637-5 BASIS OF PAYMENT.** For the items to be paid on a Dollars-Cents pay unit basis, the total cost shown in the itemized proposal will be considered the price bid even though payment will be made only for actual equipment and materials supplied. The unit price amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid for the contract.

**637-5.01 Engineer's Field Office.** The unit price bid per month for the Engineer's Field Office shall include the cost of all labor, materials and equipment necessary to complete the work including property rental, utility charges and incidental expenses. Payment will be made for each month of availability for occupancy by the Engineer and inspection field staff.

No payment will be made under Engineer's Field Office for each calendar day during which there are deficiencies in compliance with these requirements. The first calendar day shall commence 24 hours after notice to the Contractor of such a deficiency. This nonpayment shall be deducted from the next contract payment. The amount of such calendar day nonpayment will be determined by dividing the unit price bid per month by 30.

If the cited deficiencies exceeds 72 hours or is permitted to recur, liquidated damages will be assessed at 20% of the rate shown in Table 108-1 *Schedule of Liquidated Damages* of §108-03 *Failure to Complete Work on Time* for each subsequent calendar day or part thereof that the cited deficiency resulting in nonpayment is not corrected.

Monthly payments may be terminated prior to contract final acceptance by written notification by the Regional Construction Engineer that such office will no longer be required on the contract. Payment for each month's occupancy of the Engineer's Field Office after the date of contract final acceptance will be made as part of the final contract payment. Failure of the Contractor to supply documentation required to complete the final estimate may result in nonpayment during this delaying period.

During periods of contract extension of time where Engineering Charges are assessed, no payment will be made for occupancy and services, except that payment for each month's occupancy after the date of final acceptance will be made as part of the final estimate.

**637-5.02 Field Laboratory.** The unit price bid for each Field Laboratory shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including property rental, utility charges and incidental expenses.

Payment will be made for each Field Laboratory when it has been placed on the work site and is fully operational.

**637-5.03 Concrete Cylinder Curing Box.** The unit price bid for each concrete cylinder curing box shall include the cost of all labor, materials and equipment necessary to complete the work including property rental, relocation, repair or replacement, painting, cleaning, maintenance, and utility charges.

**637-5.04 Rain Gauge.** The unit price bid for each rain gauge shall include the cost of furnishing all labor, materials and equipment necessary to complete the work including installing and maintaining all components of the wireless rain gauge system.

Payment will be made for the rain gauge when it has been installed and is fully operational.

**637-5.05 Inspection Boat.** The unit price bid per month shall include the cost of furnishing all labor, fuel, maintenance, repairs, registration permits, the operator (for Type B Inspection Boats), and other necessary incidentals for operation of the boat. A deduction of 1/30 of a month will be made for each 24-hour period, or portion thereof, during which the boat is unavailable to the Engineer, or personnel authorized by the Engineer, regardless of the reason for the boat's unavailability. When directed in writing by the Engineer, payment for each month of boat use after the date of acceptance will be made as part of the final estimate. Payment will begin the first month the boat is furnished and made available for use. Monthly payments may be terminated on a specified date prior to acceptance of the Contract by written notification by the Engineer that the boat will no longer be required.

**637-5.06 Office Technology Supplies.** Office technology supplies is a “draw down” item. As the materials are supplied, the receipts shall be submitted to the Engineer. The Contractor will be reimbursed for receipted costs of materials plus 5% for profit and overhead (“materials” includes all labor, materials and equipment, including services and service contracts provided).

**637-5.07 Construction Testing Supplies – Consumables.** Construction testing supplies is a “draw-down” item. As the materials are supplied, the receipts shall be submitted to the Engineer. The Contractor will be reimbursed for receipted costs of materials plus 5% for profit and overhead (“materials” includes all labor, materials and equipment, including delivery charges from vendor sources).

**637-5.08 Partnering Workshop.** The Department will reimburse the Contractor for 50% of the costs for the facilitator and the facility upon submission of original receipts. Receipted costs eligible for 50% reimbursement include the fee for the facilitator and the costs for the facilitator’s travel and expenses; associated workshop costs such as charges for the rental of the meeting room, required audio/visual equipment and any handouts, notes or workshop materials. The costs for travel, lodging, meals and salaries of workshop attendees, other than those of the facilitator, will not be eligible for reimbursement under this item.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
637.01	Field Laboratory	Each
637.03	Concrete Cylinder Curing Box	Each
637.11	Engineer’s Field Office – Type 1	Month
637.12	Engineer’s Field Office – Type 2	Month
637.13	Engineer’s Field Office – Type 3	Month
637.14	Engineer’s Field Office – Type 4	Month
637.15	Engineer’s Field Office – Type 5	Month
637.26	Rain Gauge	Each
637.32	Inspection Boat - Type A	Month
637.33	Inspection Boat - Type B	Month
637.34	Office Technology and Supplies	Dollars-Cents

637.35	Partnering Workshop	Dollars-Cents
637.36	Construction Testing supplies – Consumables	Dollars-Cents

**SECTION 638 - WHITE SYNTHETIC RESIN BINDER CONCRETE**

**638-1 DESCRIPTION.** This work shall consist of the construction of white synthetic resin binder concrete pavement in accordance with these specifications and in reasonably close conformity with lines and grades shown on the plans or established by the Engineer.

**638-2 MATERIALS.** The materials shall meet the requirements of §402-2, Materials, except as modified below.

**638-2.01 Aggregates.** The requirements of §703-05, Fine Aggregate for White Portland Cement Concrete, shall apply except that the gradation shall meet the general limits described in §638-2.05, Mix Design. A sample of the white aggregate will be obtained by the Department from the stockpile located at the mixing plant and submitted to the Materials Bureau at least 10 days prior to the production of the mix for color approval by the Director, Materials Bureau. Unless otherwise approved by the Regional Director, the material shall be stockpiled in advance and in sufficient quantity to complete the work. Any additions to the stockpile or apparent contamination of the aggregate, as determined by the Engineer, will require submission of samples to the Materials Bureau for evaluation and approval by the Director, Materials Bureau.

**638-2.02 Mineral Filler.** Mineral Filler, if required in the mix to meet gradation requirements shall be hydrated lime.

**638-2.03 Binder.** The binder shall conform to the requirements of §702-70. The synthetic resin binder shall be supplied by a manufacturer appearing on the Department's Approved List of Synthetic Resins. When the one component binder is used, the binder shall be available 10 days prior to production of the mix so representative samples of the binder can be obtained by the Engineer and tested by the Materials Bureau for conformance to §702-70.

**638-2.04 Pigment.** The pigment shall conform to the requirements of §712-16, Pigment for Colored Synthetic Resin Binder Concrete.

**638-2.05 Mix Design.** The job mix formula stating the proposed aggregate gradation, binder and pigment contents shall be prepared by the synthetic resin binder concrete producer according to the requirements of §401-2.01, Hot Mix Asphalt Designs, except for the modifications in this specification.

The general limits for the mix are as follows:

Sieve Size	General Limits (1) % Passing	Job Mix % Tolerance
1/4 inch	100	0
1/8 inch	90–100	±5
No. 20	42–68	±7
No. 40	20–50	±6
No. 80	10–22	±3
No. 200	6–12	±2



Synthetic Binder Content (2)	7.0–8.0	_____
Pigment (1,3)	2.3–2.7	_____
Mix and Placing Temperature	250°F –325°F	_____

**NOTES:**

1. Based on total aggregate weight.
2. Based on total mix weight.
3. The pigment shall be considered as mineral filler passing the No. 200 sieve.

**638-2.06 Tack Coat.** The tack coat shall be supplied by a manufacturer appearing on the Department's Approved List of Synthetic Resins. The tack coat shall conform to the requirements of §702-71. The tack coat material shall be available 10 days prior to production of the mix so representative samples of the tack coat can be obtained by the Engineer and tested by the Materials Bureau for conformance of §702-71.

**638-3 CONSTRUCTION DETAILS.** Except as provided in this specification, the construction requirements shall meet those of §402-3, Hot Mix Asphalt (HMA) Pavements - Construction Details.

**638-3.01 Weather Limitations.** The requirements for top course mixes in §402-3.01, Weather and Seasonal Limitations, shall apply.

**638-3.02 Preparation of Mixture.** The mixing plant shall meet the requirements of §401-3.08 unless otherwise approved by the Director, Materials Bureau. Before the pugmill is allowed to produce white synthetic resin binder concrete, it shall be thoroughly cleaned by charging a minimum of two (2) successive batches of hot dry aggregate into the pugmill and mixing each batch for a minimum of four (4) minutes. In addition, the first batch of white synthetic resin binder concrete produced, after a change from normal asphalt concrete production, shall not be incorporated into the work. Such batches shall be at least fifty (50) percent of the rated pugmill capacity. This batch may also be used for the first material passed through the paver as described in §638-3.04, Paving. The white aggregate shall be introduced into the pugmill, between the limits of 250°F to 350°F and the temperature of the synthetic resin binder (one component) shall be maintained between the limits of 260°F and 300°F. When the binder is added directly into the pugmill in cold, prepackaged units (two components), the temperature of the aggregate may be increased accordingly to meet the specified mix temperature, but shall not exceed 425°F. For either method of binder addition, the resulting mix temperature shall be in the range of 250°F to 325°F.

The pigment, resin chips, plasticizing oil and hydrated lime shall be added to the pugmill in whole bag units. If the pigment and/or hydrated lime is not delivered from the manufacturers as whole units, the Contractor may weigh and repackage in a manner approved by the Engineer so that the pigment and/or hydrated lime may be added as whole units. The hydrated lime may be added in a manner approved by the Engineer, if difficulties are encountered in maintaining the specified mix temperature when adding the hydrated lime directly to the pugmill.

Batching and mixing requirements for the White Synthetic Resin Binder Concrete are as follows:

**A. One Component Binder.** After the hot aggregate is discharged into the pugmill, add the pigment and hydrated lime in whole bag units as required and dry mix for a minimum of 15 seconds. After the dry mix the synthetic resin binder should be added and wet mixed for a minimum of 45 seconds.

**B. Two Component Binder.** After the hot aggregate is discharged into the pugmill add resin chips in whole bag units as required. This should be immediately followed by the addition of the hydrated lime in whole bag units and dry mixed for 30 seconds. Following the dry mix add the plasticizing oil and pigment in whole bag units in that order and wet mix for 30 seconds after all components are in the pugmill.

Any increase in pigment content above that specified on the job mix formula for the convenience of mixing shall be made at no additional cost to the Department. The pigment content may be increased within the general limits, as directed by the Engineer, to obtain a satisfactory color during production.

**638-3.03 Preparation of Surface.** All surfaces to be paved shall be thoroughly cleaned of all foreign material, including membrane curing compound of Portland Cement concrete pavement, prior to the placing of the pavement. A tack coat, consisting of a uniform application of rapid curing synthetic resin liquid, §702-71, shall be applied at a uniform rate between 0.03 to 0.05 gallons per square yard over the areas to be paved. The tack coat shall be applied with either a paint roller or spray unit to assure uniform application. The tack coat shall not be poured onto the pavement surface for application. After the tack coat application, curing time shall be sufficient to permit the coating to become tacky before paving. No traffic shall be permitted on the tack coated surface.

**638-3.04 Paving.** The mix shall be laid between the temperatures of 250°F to 325°F as specified by the Engineer. All areas of uniform width of 4 feet or more shall be paved with an approved paving machine. Areas of narrow or variable width may be placed without a paver but in a manner approved by the Engineer. All paving edges shall be formed in a manner approved by the Engineer to obtain a true edge. The equipment including trucks, paving machine rollers and tools which come in contact with the white synthetic resin binder concrete shall be thoroughly cleaned before use. In addition, the paving machine shall be cleaned of excess asphalt by spraying with solvent. This shall be directly followed by the passage and subsequent wastage of at least one (1) ton of the white material. The material may be from the same batch used to clean the pugmill.

**638-3.05 Compaction.** Provisions of §402-3.07 Compaction shall apply except that a minimum of two passes of a nominal 10 ton steel wheel tandem roller shall be used for compaction. The edge forms shall be removed prior to applying the second roller pass. This shall be done as expeditiously as possible so that the second roller pass is completed while the mat is still hot. Forms used for the formation of transverse drainage troughs shall be kept in place until the completion of all rolling operations. Narrow areas which are subject to overstressing with a 10 ton roller may be rolled with a small roller as approved by the Engineer. The paving edge forms shall be removed prior to applying the final roller pass with the small roller as previously described for the 10 ton rollers. The use of a pneumatic tire roller will not be required for this item.

**638-4 METHOD OF MEASUREMENT.** The quantity of white synthetic resin binder concrete shall be measured by the number of tons of compacted material in place.

**638-5 BASIS OF PAYMENT.** The unit price bid per ton of white synthetic resin binder concrete shall include the cost of all materials, equipment and labor necessary to complete the work including the synthetic resin binder, pigment and tack coat.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
638.0104	White Synthetic Resin Binder Concrete	Ton

## **SECTION 639 - CONSTRUCTION CONTRACT MANAGEMENT SYSTEMS**

**639-1 DESCRIPTION.** The work in this section shall include work required for construction contract management systems.

**639-2 MATERIALS.** Materials shall be as specified in the special specifications.

**639-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**639-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**639-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 640 - REFLECTORIZED PAVEMENT MARKING PAINTS**

**640-1 DESCRIPTION.** Under this work, the Contractor shall furnish and apply painted reflectorized pavement marking paint at the locations and in accordance with the patterns indicated on the plans or as directed by the Engineer, and in accordance with the MUTCD and these specifications.

**640-2 MATERIALS.** Reflectorized pavement marking paints shall be selected from the Department's Approved List of White and Yellow Reflectorized Pavement Marking Paints. Project acceptance will be based on the appearance of an approved brand name on the container label.

All paints shall conform to Federal, State, and local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. Environmental Protection Agency, and the New York State Department of Environmental Conservation.

Reflective glass beads shall conform to §727-05 Glass Beads for Reflectorized Pavement Marking Paints.

Details for obtaining Approved List status are available from the Materials Bureau.

### **640-3 CONSTRUCTION DETAILS**

**640-3.01 General.** All pavement markings and patterns shall be placed as shown in the contract documents and in accordance with the MUTCD.

Before any pavement marking work is begun a schedule of operations shall be submitted to and approved by the Engineer.

When pavement markings are applied under traffic, the Contractor shall provide all the necessary flags, signs, cones, shadow vehicles, flashing arrow boards, etc. to maintain and protect traffic, to protect the work operation, and to protect the painted pavement markings until thoroughly dry and serviceable. No additional payment will be made for these items. The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of normal flow of traffic shall not be allowed.

The Contractor shall be responsible for cleaning the pavement, to the satisfaction of the Engineer, of dust, dirt, and other foreign material which may be detrimental to the adhesion of the paint film.

When necessary, the Contractor shall establish marking line points at 30 feet intervals throughout the length of the pavement or as directed by the Engineer.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled paint, and paint applied in unauthorized areas.

**640-3.02 Application of Pavement Markings.** At the time of paint application, the pavement surface and ambient temperature shall not be less than 50°F, the relative humidity shall not exceed 85%, and the pavement surface shall be dry. Traffic paint shall not be applied during periods of rain or if rain is imminent. Waterborne traffic paint shall not be applied if rain is expected within 4 hours after application.

Paint shall be applied in strict accordance with the manufacturer's recommendations for use. In no case shall the paint be heated above 150°F.

The painted pavement markings shall be uniformly applied to the pavement surface at the minimum specified wet film thickness. Immediately following paint application, reflective glass beads shall be uniformly applied to the wet paint film at the rate of 6 lb/gal of paint. The applied pavement markings shall have clean-cut edges and true and smooth alignment.

On pavements where traffic is to be maintained and the final marking pattern is known, traffic paint shall be applied before the end of the work shift. If the Contractor is unable to apply final pavement markings and traffic is to be maintained, then removable pavement markings offset from the final pavement markings shall be installed in accordance with Section 619 Work Zone Traffic Control at no additional cost to the State.

**640-4 METHOD OF MEASUREMENT.** Pavement striping will be measured in feet along the centerline of the pavement stripe and shall be based on a 4 inches wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown in the contract documents or as directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

No payment will be made for the number of feet of gaps in between the dashed lines. Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Examples: "SCHOOL" will be measured as six units. Double and triple headed arrows will each be measured as a single unit. The "X" in railroad grade crossing markings (MUTCD figure 263-33) will be measured by feet of 4 inch stripe.

**640-5 BASIS OF PAYMENT.** The accepted quantities of pavement markings will be paid for at the contract unit price bid, which shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the painting operations shall be included in the price bid. The application of Short-Term Pavement Markings, necessitated by the Contractor's failure to apply the required Reflectorized Pavement Marking Paints, shall be at no additional cost to the State.

*Payment will be made under:*

Item No.	Item	Pay Unit
640.10	White Paint Reflectorized Pavement Stripes – 15 mils	Feet
640.11	Yellow Paint Reflectorized Pavement Stripes - 15 mils	Feet
640.12	White Paint Reflectorized Pavement Letters - 15 mils	Each
640.13	White Paint Reflectorized Pavement Symbols - 15 mils	Each
640.20	White Paint Reflectorized Pavement Stripes – 20 mils	Feet
640.21	Yellow Paint Reflectorized Pavement Stripes - 20 mils	Feet
640.22	White Paint Reflectorized Pavement Letters - 20 mils	Each
640.23	White Paint Reflectorized Pavement Symbols - 20 mils	Each

## SECTION 641 - BRIDGE WASHING

**641-1 DESCRIPTION.** The work in this section shall include work required for bridge washing.

**641-2 MATERIALS.** Materials shall be as specified in the special specifications.

**641-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**641-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**641-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 642 - ROADSIDE MAINTENANCE**

**642-1 DESCRIPTION.** The work in this section shall include work required for roadside maintenance. Examples of the type of work are mowing, litter pick up, cleaning and shaping ditches. Work involving slope repair, asphalt patching, culvert repairs, etc shall be specified in other sections.

**642-2 MATERIALS.** Materials shall be as specified in the special specifications.

**642-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**642-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**642-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 643 - NOISE BARRIERS**

**643-1 DESCRIPTION.** The work in this section shall include work involved with construction of noise barriers.

**643-2 MATERIALS.** Materials shall be as specified in the special specifications.

**643-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**643-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**643-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 644 - OVERHEAD SIGN STRUCTURES**

(Last Revised September 2021)

### **644-1 DESCRIPTION**

**644-1.01 General.** Under this work the Contractor shall fabricate, furnish and erect sign structures for overhead signs in accordance with the contract documents.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all overhead sign structures in accordance with §106-01 Sources of Supply.

**644-1.02 Definitions.** Overhead Sign Structures (OSS) are structures with vertical supports and horizontal arms or chords used to support signs over any portion of the roadway, including the shoulders.

Span Wire Assemblies supporting overhead signs, and structures supporting both traffic signal equipment and overhead signs are covered under Section 680, Traffic Signals. Bridge fascia mounted signs, where the signage is intended for the under roadway, are also not covered in this Section.

OSS are classified into the following three standard types (See Figure 644-1).

- A. Single Arm Cantilever. Single (horizontal) arm supported by a single (vertical) post.
- B. Trussed Arm Cantilever. Two trussed arms supported by a single post. (If the arms are not trussed, the structure shall be classified as Non-Standard).
- C. Span. Single span, four-chord (quad-chord) superstructure supported by trussed end posts.

OSS that fall outside these categories are Non-Standard. This includes butterfly structures, multi-span structures, structures that are a combination of span and cantilevers, and all other overhead sign structures not included in §644-1.02.

**644-2 MATERIALS**

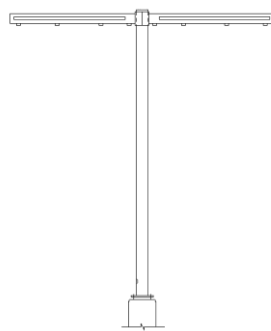
**644-2.01 Steel for Sign Structures.** Steel for component parts of sign structures shall meet the requirements of the New York State Steel Construction Manual and the following:

All material greater than 1/2 inch thick shall meet the Charpy V-Notch toughness requirements of §715-01, Structural Steel. Chords, cantilevered arms, end posts, base plates, end and face plates for cantilever arm to post connections, and flange splice plates shall be considered main members. Diagonals, struts and gusset or tab plates shall be considered secondary members. Upon receipt at the fabrication plant, all main member material shall be traceable to a mill test report and traceability shall be maintained throughout the duration of the fabrication.

All main member material thickness shall be a minimum of 1/4 inch.



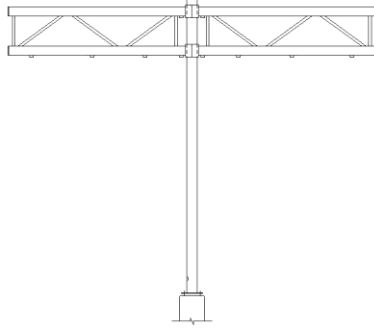
Single-Arm  
Cantilever  
Structure



Single-Arm  
Butterfly  
Structure

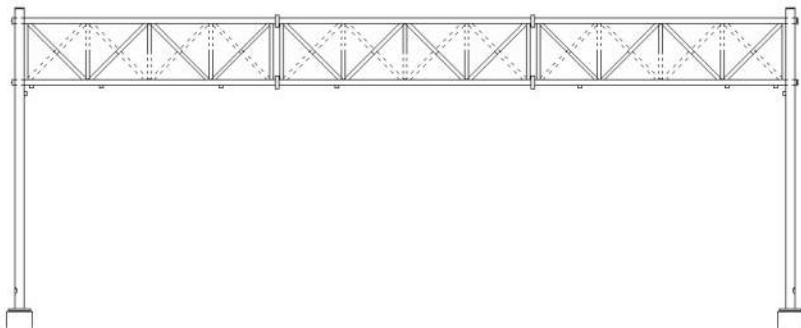


Trussed-Arm  
Cantilever  
Structure

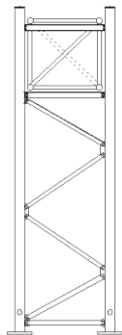


Trussed-Arm  
Butterfly Structure

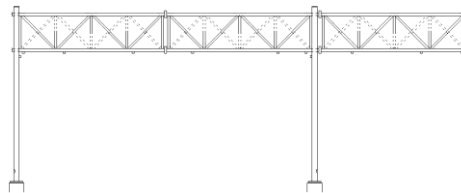
Single Span Structure



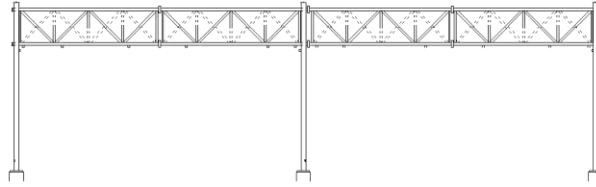
End Frame



Combination Span and Cantilever



Multi-Span Structure



**FIGURE 644-1**

**A. Pipe.** Pipe shall meet the requirements of one of the following specifications:

ASTM A53,	Welded and Seamless Steel Pipe, Grade B, Type E or S.
ASTM A500,	Welded and Seamless Steel Pipe, Grade B (Rounds Only)
ASTM A252,	Welded and Seamless Steel Pipe, Grade 2 or 3, provided that the chemical certifications meet the requirements for ASTM A53, Grade B, Type E or S.
API 5L	American Petroleum Institute Specification 5L, Grade B

In addition to the above material requirements, all pipe used for welded applications shall have a maximum Carbon Equivalency (CE) of 0.40 using the following equation:

$$CE = \%C + \%Mn/6 + \%Cu/40 + \%Ni/20 + \%Cr/10 - \%Mo/50 - \%V/10$$

**B. Structural Steel.** Structural steel for structural shapes, plates, and bars shall meet the requirements of §715-01, Structural Steel, and the ASTM Specification noted on the contract documents. Cutting and drilling shall be done in such a manner that the resulting surfaces are free from any gouges or burrs.

**C. Anchor Bolts, Nuts and Washers.** Anchor bolts, nuts and washers shall meet the requirements of the following:

ASTM F1554,	Grade 55 with Supplementary Requirement S4, Charpy Impact Requirement
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Anchor bolts, nuts, and washers shall be galvanized in accordance with the requirements of Materials Detail 719-01 Type II, Galvanized Coatings and Repair Methods - Zinc Coating (Hot Dip) on Iron and Steel Hardware. Anchor bolts shall be the Unified Course Thread Series with Class 2A threads, and shall be galvanized full length. Nuts shall be Grade A, Heavy Hex.

**D. High Strength Steel Bolts, Nuts and Washers.** Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of §715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of §719-01, Galvanized Coatings and Repair Methods. Additionally, the Contractor shall provide documentation that the zinc coated fastener assemblies have satisfied the requirements of ASTM A3125 Annex 2 Rotational Capacity testing.

Fasteners in main members shall be sampled and tested in accordance with Section 1001.5 of the New York State Steel Construction Manual, with the exception that the waiver for lot sizes less than 20 bolts shall not apply.

**E. U-Bolts.** U-Bolts shall conform to material specification ASTM F1554, Grade 36, and shall be galvanized in accordance with the requirements of Type II of §719-01, Galvanized Coatings and Repair Methods.



**F. Galvanizing.** All steel shall be galvanized in accordance with §719-01 Type I, except as noted above in §644-2.01 C, D & E. Galvanizing shall provide a minimum coating of 3.9 mils. All welding, cutting and drilling shall be done prior to galvanization, and all bolting shall be done after galvanization, except as approved by the Engineer.

**G. Acceptance.** All steel furnished shall be documented in accordance with the requirements of §715-01 Basis of Acceptance.

**644-2.02 Concrete.** All overhead sign structure foundations shall meet the requirements of Class A concrete in Section 501, Portland Cement Concrete - General. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

All precast concrete overhead sign structure foundations shall meet the requirements of §704-03, Precast Concrete - General.

For situations which require depositing structural concrete under water, provide Class G concrete as described in Table 501-3 *Concrete Mixtures* and Table 501-3A *Pozzolan Substitutions*. For design and construction purposes, the minimum compressive strength of concrete used in the foundations shall be 3000 psi @ 28 days.

### **644-3 CONSTRUCTION DETAILS**

**644-3.01 Drawings.** Shop drawings shall be required for all OSS in the contract documents. The Contractor must submit shop drawings in accordance with the requirements of Section 2 in the New York State Steel Construction Manual.

**644-3.02 Fabrication.** All fabrication shall be performed in accordance with the requirements of the New York State Steel Construction Manual.

**A. Storage of Materials.** Structural material shall be stored in a manner that will protect the materials from deformation, surface deterioration and accumulations of dirt, oil, or other foreign matter.

**B. Straightening Materials.** Prior to fabrication in the shop, all deformed structural materials shall be properly straightened by methods which are non-injurious. Sharp kinks and bends, and deep dents shall be cause for rejection.

**C. Anchor Bolts.** Where anchor bolts have been or are being set under a separate contract, the Contractor shall check the size, location, and spacing of anchor bolts before fabricating the structure.

**D. Pole Markings.** A Sign Structure Identification Number (SIN) shall be attached to the post using white numbers on a green background. The background shall be Green, Class A, Engineer Grade reflective sheeting as described in §730-05, Reflective Sheeting, and shall be 12 inches wide by 6 inches high, with the corners cut to a 1 1/2 inch radius. The numbers shall be cut out from White, Class A, Engineer Grade reflective sheeting and shall be 3 inches high. The sheeting and numbers shall be applied in accordance with the manufacturer's recommendations. The numbers shall be placed on the right near post, 45 degrees from the viewing direction of traffic, approximately 6 feet above the base plate, so as to be visible to the traveling public. For structures spanning more than one direction of traffic, or structures that span non-contiguous travel lanes, two posts shall be marked to facilitate identification by inspectors.

The following information shall be stamped into the base plate in 1/2 inch letters to such a depth as to be clearly visible through subsequent galvanizing:

<b>Required Information</b>	<b>Example</b>
Manufacturer's name or logo	ABC Fabricating
Month and year of manufacture	06/2003
D Number	D123456
SIN Number	SIN 12345

For span type structures the marked base plate shall correspond to the marked posts, except that only one end of the span must be marked.

**E. High Strength Bolts.** Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.3b of the New York State Steel Construction Manual.

Fasteners shall be inspected after installation in accordance with Section 1001.4 of the New York State Steel Construction Manual. The inspection shall apply to a minimum of 10% of the connections randomly throughout the entire span of the structure.

All holes for high strength bolts in main members shall be made in accordance with Section 613 of the New York State Steel Construction Manual. This requirement also includes all secondary members that are welded to main members.

**F. Quality.** Fabricators shall be certified in accordance with the American Institute of Steel Construction's Quality Certification Program in the Simple Steel Bridge Structures Category, or an equivalent program acceptable to the DCES.

**G. Inspection.** Provisions for shop inspection shall be in accordance with the New York State Steel Construction Manual.

**H. Assembly.** All OSS shall be fully assembled in the fabrication shop to ensure proper fitup.

**I. Acceptance For Shipping.** Each section of a sign structure shall bear the QA inspector's mark of acceptance prior to shipping.

**644-3.03 Transportation.** Sign structures (including posts and post assemblies) shall be shipped by flat bed trailer or other similar means. Structures shall be shimmed, braced, blocked, and tied down to prevent distortion or other damage from occurring during transportation. The use of any device which does not support the member for its entire length, as described below, shall not be permitted. This prohibition includes, but is not limited to, dolly wheels and pole trailers.

Sections less than 50 feet in length shall be, at a minimum, supported at the midspan and end points. Sections 50 feet and longer shall be, at a minimum, supported at the ends and at the quarter points.

Adhering to these requirements does not relieve the Contractor of the responsibility for damage to the structure en route.

**644-3.04 Excavation.** All excavation shall conform to Section 206, Trench, Culvert and Structure Excavation.

Excavation shall not be performed until immediately before installation of the footings, or any other appurtenances. The excavated material shall be placed in a location or locations selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to avoid interference with surface drainage. All surplus excavated material shall be removed and disposed of by the Contractor as specified in Section 203, *Disposal of Surplus Excavated Material*

Excavation shall be backfilled as specified in Section 203, *Select Structure Fill*. The outline of all areas to be removed in sidewalks, driveways, and pavement shall be saw cut to a depth of at least 3 inches prior to removal. Cuts shall be neat and true along score lines with no shatter outside the removal area. Damaged saw cut areas shall be recut.

Pavement, shoulder, sidewalks, curbs, driveways, lawns, plants and other such features shall be replaced in kind with material of equal quality or as shown in the contract documents. For transverse sidewalk, curb or gutter cuts in concrete the entire square or section shall be removed and replaced with the same kind and quality of material. For longitudinal cuts in concrete sidewalks only the area removed between sawcuts shall be replaced unless specified otherwise in the contract documents.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter or driveway is broken or damaged by this work, the entire square, section or slab shall be removed and replaced with the same kind and quality of material, at no additional cost to the State.

**644-3.05 Concrete Foundations.** Foundations shall be constructed as shown in the contract documents. The Contractor shall establish the location and elevation of foundation, prior to the start of construction, based on the information shown in the contract documents and data derived from field surveys. Locations and elevations will be verified by the Engineer prior to the start of construction.

The Contractor has the option, unless specifically disallowed in the contract documents, to use either Drilled Shafts or Rectangular Footings for Overhead Sign Structures, if both types are detailed in the contract plans. When both foundation types are detailed and permitted, the Department has prepared the contract documents based on the presumed less expensive foundation type. If the Contractor elects to change from one type of foundation to the other under this option, it shall be done at no additional cost to the State. The Contractor shall notify the Engineer of the decision to change foundation type.

Excavation for these items shall be as specified in §644-3.04. All concreting operations shall conform to Section 555, Structural Concrete. Reinforcing steel shall conform to Section 556, Reinforcing Steel for Concrete Structures.

The allowable tolerance from verticality for the drilled shaft or pedestal shall be 2.5%. The allowable tolerance for the top of shaft elevation or pedestal elevation shall be + 1/4 inch, -0 inch.

Stripping of forms and subsequent loading of foundations shall be in accordance with §555-3, in Table 555-4, under "Pier Columns". Placing the sign panels on an overhead sign structure is assumed to be equivalent to placing superstructure loads on a bridge.

**A. Drilled Shafts for Overhead Sign Structures.** Work under this item shall consist of the layout and construction of Drilled Shaft foundations for Overhead Sign Structures. This work may require rock drilling, installing rock sockets, dewatering, the use of temporary casing, slurry, or other means necessary to keep the hole open. Formwork shall be required for the portion of the shaft above finished grade.

Holes for drilled shafts shall be pre-augered. Precaution shall be taken to protect the holes from collapse. Holes shall contain no free water, nor any loose material at the time of concrete placement. The holes shall be filled with Class A concrete placed in direct contact with the soil. Casing, if used, shall be removed prior to concrete placement. If unable to dewater the shaft and place Class A concrete due to the presence of groundwater and loose cohesionless soil at the base of the drilled shaft, proceed with the installation by not dewatering the shaft excavation and place Class G tremie concrete in accordance with §555-3.05 Depositing Structural Concrete Under Water. The bottom of the shaft excavation shall be cleaned of loose material to the satisfaction of the Engineer immediately prior to concreting. Where a temporary casing is used to assist in pouring a concrete shaft, the casing shall be removed as the concrete is placed.

Precast shafts shall not be permitted.

**B. Rectangular Footings for Overhead Sign Structures.** Work under this item shall consist of the layout and construction of conventional rectangular spread footings, either cast-in-place or precast. This work may require the use of protective sheeting.

### 644-3.06 Erection of Sign Structures

**A. Methods and Equipment.** Before starting work, the Contractor shall submit details of the method of erection and types of equipment he proposes to use, to the Engineer for review and approval. Approval shall not relieve the Contractor of the responsibility for the safety of the methods or equipment, or for damage to the structures due to overloading.

**B. Handling and Storage.** Structural members shall be loaded, moved, and unloaded in a manner that prevents stresses in excess of those provided for by the structure design. Permanent distortion, or other damage attributable to the Contractor's operations, shall be cause for rejection.

Members stored either in the fabricator's storage area, or at the work site, or at other storage areas, shall be supported off the ground in a manner that will not allow distortion, or other damage to occur.

**C. Lifting.** Erection of overhead sign structures shall be done in accordance with §107-05P. *Lifting.* Lift Plans are required, and shall be provided in accordance with §107-05P.3. Nylon slings, or an equivalent approved by the Engineer, shall be used for all lift operations. Picking points for the superstructure portion of span type OSS shall be made at the panel points that are closest to the third points of the span, in order to ensure that no members are overstressed during lift operations. Two picking points, one at each end, shall be used for the superstructure portion of cantilever OSS. Picking shall be made by wrapping the entire cross section of the structure. When alternate pick points are used, supporting calculations shall be submitted in accordance with §107-05P.5. *Lift Operations.* However, lifting by chains or by individual members shall not be permitted.

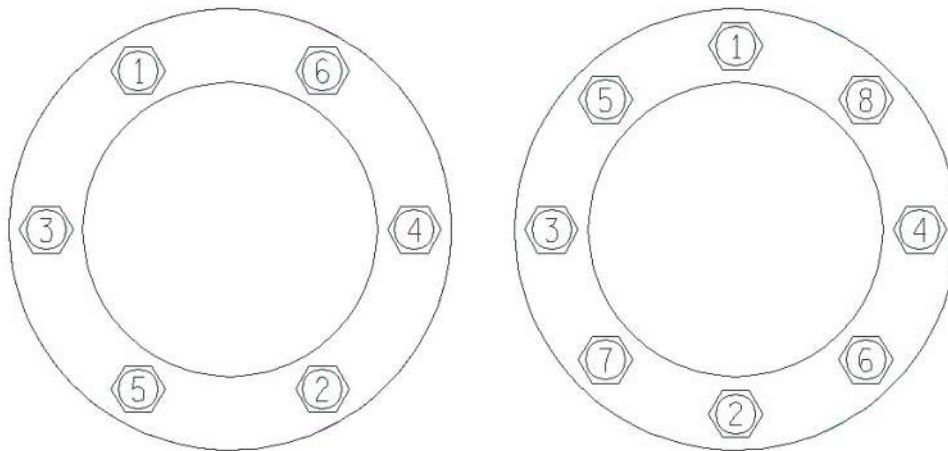
**D. Field Inspection.** All sign structures shall be visibly inspected, and components shall be clean prior to erection. Damage that is attributable to the Contractor's operations shall be cause for rejection. Damage includes, but is not limited to, bends, kinks, dents, cracks and pits. Rejected structures, or components, shall be removed from the work site and repaired, or replaced as required by the DCES. All work relating to the repair or replacement, of defective structures, or components, shall be done at no additional cost to the State.

**E. Anchor Bolts.** The following procedure shall be used for placing and tightening anchor bolts:

1. Anchor bolts shall be carefully set to the proper location, alignment, and elevation by using templates. Templates shall be as detailed in the contract documents, and shall be used at both the top and bottom of the anchor bolt pattern. Bottom templates shall be cast into the footing. Top templates shall be placed near the top of the anchor bolts so as not to interfere with concrete operations, and shall be left in place for 24 hours after concrete placement. Undamaged top templates may be reused.
2. Anchor bolts shall be set vertical, within 2.5%, and shall not be realigned by bending to fit the base plate. Anchor bolts that do not fit the base plate, or anchor bolts that are more than 2.5% out of plumb, shall be rejected. The Contractor may propose a remediation method for rejected anchor bolts, subject to the approval of the Engineer. Rejected anchor bolts, and the concrete they are embedded in shall be replaced by new materials at no cost to the State.
3. The exposed portion of the anchor bolts shall be cleaned with a wire brush. The leveling nuts and washers under the base plate shall be threaded onto the anchor bolts, leaving a gap between the top of concrete and the bottom of the leveling nuts of no more than one anchor bolt diameter, and no less than 3/8 inch.

4. The post(s) alone, without the arms attached, shall be placed on the leveled anchor bolts and washers. Posts shall not be raked back to account for camber. The base plate shall bear directly and evenly on the washers and leveling nuts.
5. Beeswax, or the equivalent, shall be applied to the bearing face and the threads inside the top nut. The top anchor bolt nuts and washers shall then be placed and tightened by hand. All cleaning and lubricating shall be done immediately prior to nut placement and tightening. Top nuts and leveling nuts shall be checked for full bearing against the base plate, and any loose nuts shall be tightened by hand. The top nuts shall then be snug tightened using 20 - 30% of the torque values listed in Table 644-1. The snugging sequence shall be as shown in Figure 644-2. The leveling nuts shall then be similarly checked for snug tightness, using 20 - 30% of the values listed in Table 644-1.
6. Fully tighten all top nuts according to the torques listed in Table 644-1. The tightening sequence shall be as shown in Figure 644-2. There shall be no rotation of the leveling nut during this procedure.
7. An additional nut shall be installed and tightened against the top nut to lock the installation. This lock nut shall be prepared and tightened as defined in 5.) and 6.) above. There shall be no rotation of the lower top nut during this procedure.

<b>TABLE 644-1</b>	
<b>Anchor Bolt Size (English)</b>	<b>Required Torque (<math>\pm 5\%</math>) (ft-lbs)</b>
1 ½	650
1 ¾	1,000
2	1,500
2 ¼	2,200
2 ½	3,000



Anchor Bolt Star Pattern Tightening Sequence  
 6 Bolt Pattern                      8 Bolt Pattern

## FIGURE 644-2

**F. Bolting.** Bolted steel connections shall be made with bolts, nuts and washers meeting the material requirements of §715-14, High Strength Bolts, Nuts and Washers, and the galvanizing requirements of §719-01, Galvanized Coatings and Repair Methods. Each bolt shall be furnished with a galvanized flat washer installed under the turned element. All connections shall be made by first tightening all nuts and bolts sufficiently to bring all components into full contact with each other. Any gaps between the faying surfaces after snug tightening that exceed 1/16 inch shall not be considered in full contact and shall be cause for rejection. The Contractor may propose remediation measures subject to approval by the DCES. Rejected components shall be replaced or repaired at no cost to the State. Bolts shall not be fully tightened before said tolerances are checked. After full contact has been achieved, all connections shall be brought to a condition beyond snug tight as required by Table 1001.3b of the New York State Steel Construction Manual.

Fasteners shall be inspected after installation in accordance with Section 1001.4 of the New York State Steel Construction Manual.

**G. Welding.** Field welding shall not be permitted on any part of the structure, except as approved by the DCES.

**H. Galvanized Metal Repair.** The Contractor shall repair any damage to galvanized surfaces in conformance with the field repair requirements specified in §719-01, Galvanized Coatings and Repair Methods, except that zinc paint applied by the spray method shall not be permitted.

### 644-4 METHOD OF MEASUREMENT

**644-4.01 Sign Structure.** The work will be measured as the number of sign structures installed without sign panels.

**644-4.02 Drilled Shafts for Overhead Sign Structures.** The payment quantity shall be the concrete volume shown for the shaft in the table in the contract documents, multiplied by the number of drilled shafts in the contract, unless the Engineer orders a modification to the details shown in the contract documents. If the Engineer orders a modification to the details shown in the contract documents, the payment quantity shall be the volume of concrete ordered by the Engineer. If the Engineer orders a change from a drilled shaft to a rectangular footing, an order-on-contract shall be negotiated. No adjustment shall be made for the Contractor's election to use a rectangular footing, unless the Engineer orders a change to the details shown in the contract documents.

**644-4.03 Rectangular Footing for Overhead Sign Structures.** The payment quantity shall be the concrete volume shown for the footing and pedestal in the table in the contract documents, multiplied by the number of footings in the contract, unless the Engineer orders a modification to the details shown in the contract documents. If the Engineer orders a modification to the details shown in the contract documents, the payment quantity shall be the volume of concrete ordered by the Engineer. If the Engineer orders a change from a rectangular footing to a drilled shaft, an order-on-contract shall be negotiated. No adjustment shall be made for the Contractor's election to use a drilled shaft, unless the Engineer orders a change to the details shown in the contract documents.

**644-4.04 Anchor Bolts.** The payment quantity shall be the mass shown in the anchor bolt table in the contract documents times the number of bolts installed.

### 644-5 BASIS OF PAYMENT

**644-5.01 Sign Structure.** The unit price bid for each structure for supporting sign panels shall be compensation in full for fabricating, furnishing and erecting the structure complete as specified including upright support(s), span and/or cantilever arm or truss assemblies, diagonal bracing, all necessary hardware, nuts, bolts, and washers, and all other material, equipment and labor necessary to properly complete the work as shown in the contract documents and called for in the specifications. Footings and anchor bolts shall be paid for under separate items or will be furnished by others.

The cost of all shop drawings, prints and reproducible prints required by the New York State Steel Construction Manual shall be included in the unit price bid for this item.

**644-5.02 Foundations for Overhead Sign Structures.** The unit price bid per cubic yard shall include the excavation, any protective system(s) required to ensure the safety of the workers and the public, dewatering, backfill (select granular backfill or concrete), formwork, concrete, bar reinforcement for concrete, excavation and backfilling of test holes, conduit and fittings, restoration of surfaces in kind, disposal of excess excavated material, and saw cutting.

**644-5.03 Anchor Bolts.** The unit price bid pound shall include the furnishing and installing the anchor bolts and all necessary hardware, including galvanizing, as shown in the contract documents and called for in the specifications. This includes the anchor bolts, all templates used to ensure the proper alignment of the anchor bolt system, all nuts, and all washers necessary to complete the work as shown in the contract documents.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
644.11	Anchor Bolts	Pound
644.20	Drilled Shaft for Overhead Sign Structures	Cubic Yard
644.30	Rectangular Footing for Overhead Sign Structures	Cubic Yard
644.41xxyy	Single Arm Cantilever Sign Structure	Each
644.42xxyy	Trussed Arm Cantilever Sign Structure	Each
644.43xxyy	Single Span Sign Structure	Each
644.44nn	Non-Standard Sign Structure	Each

**NOTE:**

- xx, yy and nn denote serialized pay items. See §101-02, Definition of Terms, under "Specifications".
- xx denotes span or arm length in yards. For Single Arm and Trussed Arm Cantilever Sign Structures, xx varies from 04 to 16 in whole number increments. For Single Span Sign Structures, xx varies from 15 to 65 in 5 yard increments.
- yy denotes sign area in square yards. For Single Arm Cantilever Sign Structures, yy is 03, 05 or 08 square yards.. For Trussed Arm Cantilever Sign Structures, yy varies from 05 to 30 in 5 square yard increments. For Single Span Sign Structures, yy varies from 30 to 90 in 30 square yard increments.

**SECTION 645 - SIGNS**

(Last Revised September 2021)

**645-1 DESCRIPTION.** This work shall consist of fabricating, installing and covering traffic sign panels, sign support systems, sign posts, and illuminated sign panels in accordance with the contract documents, standard sheets, the MUTCD and as directed by the Engineer.

**645-1.01 Definitions.** The following definitions shall apply to all work equipment and materials included under this section:

1. Sign Face - the side of a sign panel with reflective sheeting attached.
2. Sign Face Layout - a dimensional representation of the sheeting mounted on the sign panel.

3. Sign Panel - a uniform sheet of aluminum or fiberglass reinforced plastic with reflective sheeting mounted on it. It may be constructed with or without additional sheets of aluminum or fiberglass reinforced plastic attached on the larger sheet. Multiple sheets of aluminum or fiberglass reinforced plastic may be used provided the sheets are of a uniform material and thickness and not separated.
4. Sign Panel Assembly - a group of contiguous sign panels with a maximum separation of 6 inches.
5. Sign Support System - the apparatus a sign panel is mounted.

## 645-2 MATERIALS

**645-2.01 General.** Materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*:

Wood Preservative - Water Borne	708-31
Stress Graded Timber and Lumber	712-14
Stainless Steel Connecting Products	715-16
Rubber Impregnated Woven Cotton-Polyester Fabric	728-01
Rubber Impregnated Random Fiber Pad	728-02
Aluminum Sign Panels	730-01
Retro-Reflective Sign Sheeting	730-05
Stiffeners, Overhead Brackets, and Miscellaneous Hardware	730-22
Fiberglass Reinforced Plastic Sign Panels	730-23
Type A Sign Supports	730-24
Type B Sign Posts	730-25
Breakaway Bases and Hinge Assemblies	730-26
U-Bolts	ASTM F1554, Grade 36

### 645-2.02 Sign Panels.

Fabricate sign panels in strict accordance with Department Standard Sheets and the sign sheeting manufacturer's guidelines, to ensure uniform appearance and brilliance, under both nighttime and daytime conditions. Fabricate sign panels in a manner to provide an even, clear, uniform surface, free of streaks, drips or other defects which might affect appearance or retro-reflectivity. Details for signs that are not shown on the standard sheets shall be similar to the closest shown sign blank size.

Holes on panels may be punched or drilled. Edges shall be smooth and true and free from burrs or ragged breaks.

Coat and/or edge seal all backgrounds, characters, delineators, etc., in accordance with the sheeting manufacturer's recommendations.

Clearly mark all sign panels in the lower right corner on the back of the sign panel to show the Contract Number and the installation date (month/year). Markings shall be a minimum of 1 inch high and shall be permanently engraved, labels attached with pressure-sensitive adhesives, marked with an indelible ink or paint, or established by another method approved by the Engineer.

**Mounting Hardware:** U-Bolts used to attach sign panels to overhead sign structures shall be Type II galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods*.

#### A. Ground-Mounted Sign Panels.



**1. Ground-Mounted Sign Panels less than or equal to 32 square feet without Z-bars.**

Aluminum Sign Panels: 12 gauge (0.0808 inch) minimum in thickness  
Or

For sign panels up to 4 ft X 4 ft - Fiberglass Reinforced Plastic Sign Panels: 0.135 inch (minimum) in thickness.

**2. Ground-Mounted Sign Panels less than or equal to 32 square feet with Z-bars.**

Aluminum Sign Panels: 12 gauge (0.0808 inch) minimum in thickness  
Or

For sign panels up to 4 ft X 4 ft - Fiberglass Reinforced Plastic Sign Panels: 0.135 inch minimum in thickness.

**3. Ground-Mounted Sign Panels greater than 32 square feet (with Z-bars).**

Aluminum Sign Panels: 8 gauge (0.1285 inch) in thickness

**B. Overhead-Mounted Sign Panels.**

Aluminum Sign Panels: 8 gauge (0.1285 inch) in thickness

**C. Sign Panels with Multiple Sheeting types.** The panel thickness for sign panels with multiple types of sheeting types shall be determined using the total area of the sign panel and meet the materials requirements above.

**D. Retro-Reflective Sheeting.** Use NYSDOT Class A sign sheeting for all sign types.

**Note:** Signs supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type III/IV and IX retro-reflective sign sheeting based on the sign type and pay item.

**E. Sheeting Sign Characters.** Characters include letters, numerals, route shields, symbols, logos, and borders. Characters shall be the size, series and color specified in the MUTCD and as specified in the contract documents.

- a. Cut-out characters shall be of the same type sign sheeting as the background sheeting. Black cut-out characters shall be non-retro-reflective. Apply cut-out characters directly to clean, dust-free retro-reflective sheeting background panels and as specified by the sheeting manufacturer. Neatly cut all borders and edges and butt-join at corners and panel joints.
- b. When painting, screening, reverse screening and/or other similar methods, use materials, equipment and procedures specified by the sign sheeting manufacturer.
- c. To digitally print signs, use the sign sheeting manufacturer's recommended, match component system and materials, including their recommended final top-coat or overlay.

Clear coat, overlay and/or edge seal the entire sign face area after the sign has been completed, as specified by the sheeting manufacturer.

**F. Sign Face Layouts.** Sign face shape, color, dimensions, and characters shall be in accordance with:

1. Manual on Uniform Traffic Control Devices for Streets and Highways (FHWA).
2. New York State Supplement to the National Manual on Uniform Traffic Control Devices for Streets and Highways
3. Standard Highway Signs Book – (FHWA)

After contract award, two copies of non-standard sign face layouts will be provided to the

Contractor. The Contractor shall verify dimensions on the sign face layouts prior to fabrication. (Standard sign face layouts for MUTCD codes without the prefix NY are shown in the Standard Highway Signs Book written by the Federal Highway Administration.)

**G. Sign Structure Bearing Pads.** Type A Sign Structure Bearing Pads shall be made from Rubber Impregnated Woven Cotton-Polyester Fabric. Type B Sign Structure Bearing Pads shall be made from Rubber Impregnated Random Fiber Pad

**645-2.03 Type A and High-Capacity Type A Sign Posts.** Type A sign posts shall be selected from the Department's Approved List of Type A Sign Supports. The standard strength (i.e., moment capacity) of a Type A sign post shall be 2100 ft-lbs., although weaker or stronger posts may be substituted.

- A. Type A Sign Posts with Extra Embedment and Soil Plates.** Type A sign posts with extra embedment (more than 39 inches) and with soil plates shall meet the requirements of the Materials Details for Type A sign Supports.
- B. High-Capacity Type A Sign Posts.** High-Capacity Type A sign posts are those Type A Sign Supports that has a moment capacity between 5000 ft-lbs. and 7000 ft-lbs. per post. The Contractor shall calculate the design moment at the base of the longest post and select an appropriate High-Capacity Type A sign post system - consisting of two or three High-Capacity Type A sign posts of the same type capable of resisting that moment, subject to the Engineer's approval.

**645-2.04 Type B Sign Posts.** Type B sign posts shall be fabricated in accordance with the requirements of '730-25 *Type B Sign Posts*.

**A. Rustic Type B Sign Posts.** Rustic Type B sign posts shall be ungalvanized weathering steel meeting the requirements of ASTM A588 or A242.

**B. Breakaway Bases and Hinge Assemblies.** Breakaway bases and hinge assemblies shall be fabricated in accordance with the requirements of '730-26 *Breakaway Bases and Hinge Assemblies*.

**645-2.05 Concrete Foundations.** Cast-in-place concrete for foundations shall meet the requirements of Class A concrete in Section 501, *Portland Cement Concrete-General*. Precast concrete foundations shall meet the requirements of '704-06 *Precast Concrete Cribbing*. The batching, mixing and curing methods, and the inspection facilities shall meet the approval of the Department. The Contractor may submit a mix at least equivalent to Class A Concrete for approval by the Engineer.

**645-2.06 Breakaway Wooden Sign Posts.** Breakaway wooden sign posts shall be either Grade 2 Southern Yellow Pine or Grade 2 Douglas Fir-Larch, surfaced four side (S4S) as designated by the National Design Specification (NDS) for Wood Construction, and meeting the requirements of '712-14 *Stress Graded Timber and Lumber*. The bending stress (Modulus of Rupture) shall not be less than 3900 psi using the clear wood properties of ASTM D2555. Posts shall be pressure treated in accordance with '708-31 *Wood Preservative - Water Borne*, dried to a maximum moisture content of 15% before and after pressure treating. The embedded portion of each post shall be sealed to 2 inches above the ground surface or above the steel tube insert, with a heavy coat (12 mil dry film thickness) of an emulsified asphalt conforming to AASHTO M140.

All 3 1/2 inch x 5 1/2 inch posts shall have two 1 1/2 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches above grade and filled with flexible caulk. All 5 1/2 inch x 7 1/2 inch posts shall have two 3 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches above grade and filled with flexible caulk. Nails and fasteners shall be stainless steel meeting the requirements of '715-16. Cuts and holes

made at the contract site shall be field treated with copper naphthenate having a minimum 2% metallic solution, in accordance with AWWPA Standard M4. Breakaway holes shall be field treated with copper naphthenate before filling with flexible caulk.

**645-2.07 Pole-Mounted Sign Support System.** Bands, brackets, hardware, and fasteners necessary to mount a sign panel or a sign panel assembly on traffic signal poles, street lighting poles or other poles shall be stainless steel. Bands shall be a minimum of 0.75 inch x 0.02 inch. Other methods of attachment may be substituted with prior written approval of the Engineer. A sign panel assembly is defined as a group of contiguous sign panels with a maximum separation of 6 inches.

**645-2.08 Illuminated Signs.** Illuminated Sign Panels shall be aluminum alloy 8 gauge thick meeting the requirements of '730-01, *Aluminum Sign Panels*. All materials necessary to illuminate the sign panels shall be as shown in the contract documents.

**645-2.09 Sign Covering Material.** (Vacant.)

### 645-3 CONSTRUCTION DETAILS

**645-3.01 General.** Sign panels, overhead panels, overhead vertical brackets, vertical and horizontal Z-bars, sign support systems, sign posts, breakaway bases and hinge assemblies, and foundations for Type B sign posts shall be constructed in accordance with the contract documents, standard sheets, MUTCD and materials details. Sign locations shown in the contract documents are approximate, and the exact location for each sign will be approved by the Engineer in the field.

The Contractor shall erect new signs and remove existing signs in such a manner that the traveling public is provided all necessary regulatory, warning, and guidance information at all times. Certain items may be designated to be performed prior to other items of work.

An inspection of installed signs will be made in the daylight for color, reflectivity, location, vertical post alignment, visibility, and appearance. The installed signs will also be inspected at night for color, orientation and reflectivity, traits which will be more conspicuous at night.

**A. Wind Loads.** The wind pressures given on the standard sheets have been calculated according to the procedure in the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1994)*. All wind loading shall be adjusted for height, drag, and gusting in accordance with AASHTO's *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (1994)*. Allowable sign areas shall be reduced when the sign centroid height is at an elevated site condition (e.g., an overpass) where the influence of the ground on the wind is reduced. For example, a sign centroid between 29 feet and 49 feet above the existing ground would result in a 37.5% increase in wind pressure (refer to the section "Loads" in aforementioned AASHTO Specifications).

TABLE 645-1 WIND LOAD CRITERIA				
	Region	Wind Velocity (mph)	Wind Pressure at Panel Centroid # 14.0 ft (psf)	Wind Pressure at Panel Centroid > 14.0 ft (psf)
<b>Type A Post</b>	1, 2, 6, 8, and 9	60	14.4	19.2
	3, 4, 5, 7, 10, and 11	70	20.4	25.2
<b>Type B Post</b>	1, 2, 6, 8, and 9	70	NA	25.2
	3, 4, 5, 7, 10, and 11	80	NA	33.6

**NOTE:** Panel centroid height measured above the surrounding terrain.

**645-3.02 Sign Panels.** Sign panels shall be installed as shown on the standard sheets or as shown in the contract documents. Layout of sign panels and assemblies shall be as shown in the contract documents. Aluminum Overhead Mounted Sign Panels shall be separated from steel overhead sign structures in order to prevent corrosion by a Type A Sign Structure Bearing Pad or a Type B Sign Structure Bearing Pad as shown in the contract documents.

**645-3.03 Type A and High-Capacity Type A Sign Posts.** The Contractor shall install Type A sign posts individually or in groups to provide the required total moment resistance.

**A. Type A Sign Posts with Extra Embedment and Soil Plates.** Type A sign posts with Extra Embedment, and Soil Plates for Type A sign post, shall be installed where extra embedment depth and/or soil plates are required.

**B. High-Capacity Type A Sign Posts.** High-Capacity Type A sign posts shall be installed where extra moment capacity is required. Number of posts and spacing shall be as per manufacturer's recommendations and Standard Sheets.

The number of Type A sign posts indicated in the contract documents is based on the information available during design. The number and strength of Type A sign posts installed shall be based on conditions at the final sign location approved by the Engineer. The Contractor shall determine the required moment resistance for the Type A sign post(s) due to the wind loads indicated in ' 645-3.01A.

*Wind Loads*, and propose an appropriate number and strength of Type A sign posts for the approval of the Engineer. The Contractor shall submit the approved Materials Details, and any computations, to the Engineer, and install the required number of Type A sign posts subject to the following criteria:

1. For signs with a nominal width greater than 30 inches, at least two posts are required, except that the nominal 30 inch x 30 inch diamond panel and the nominal 36 inch wide "YIELD" panel require only one post.
2. The maximum number of posts installed within a 7 foot path shall be as described on the approved Materials Details.
3. For single flanged channel post installations only, the required moment resistance for the post shall be increased by 25% to account for torsional shear. The Materials Details include this adjustment.

**645-3.04 Type B Sign Posts.** The Contractor shall install Type B sign posts, breakaway bases, hinge assemblies and foundations in accordance with the details shown on the standard sheets or the manufacturer's approved materials details.

The Type B sign post type, size and number shown in the contract documents are based on the information available during design. The sign post type, size and number to be installed by the Contractor shall be based on conditions at the final location approved by the Engineer. The Contractor shall determine the required moment resistance for the Type B sign post(s) based on the wind loads indicated in ' 645-3.01A. *Wind Loads* and verify the sign post type, size, number, hinge capacity and 7 feet wheel path criteria for the approval of the Engineer. The Contractor shall submit any computations to the Engineer.

The Contractor may install breakaway type bases under the contract pay item for nonbreakaway type posts provided that nonslotted hinge plates are used on both flanges and the installation is outside the clear zone or otherwise protected.

**A. Rustic Type B Sign Posts.** Rustic Type B sign posts shall be installed in the same manner as Type B sign posts.

**B. Breakaway Bases and Hinge Assemblies.** Breakaway bases and hinge assemblies shall be installed in accordance with the standard sheets or the manufacturer's approved materials details.

When breakaway bases and hinge assemblies are used with rustic Type B sign posts, the breakaway bases and hinge assemblies shall be installed as follows:

1. The front (approach) flange hinge plate of rustic Type B sign posts shall be installed as shown on the contract drawings, except that an additional galvanized steel flat washer shall be installed on all four bolts between each post and the slotted hinge plate to assure proper slippage.
2. All miscellaneous visible galvanized steel hardware, except in the vicinity of the hinge plate slots, shall be painted with Weathered Brown Guide Rail Paint.

**645-3.05 Concrete Foundations.** Concrete foundations shall be constructed in accordance with the Materials Detail Sheets and contract documents. Upon completion of the sign installation the Contractor shall restore the area to its original state.

<b>TABLE 645-2 ALLOWABLE SIGN AREAS (SF) ON 2 BREAKAWAY WOODEN POSTS</b>									
<b>Wooden Post Section (inches)</b>	<b>Embedment (ft)</b>	<b>60 mph Wind Velocity</b>				<b>70 mph Wind Velocity</b>			
		<b>Height to Panel Centroid (ft)</b>				<b>Height to Panel Centroid (ft)</b>			
		6.0	8.0	10.0	12.0	6.0	8.0	10.0	12.0
<b>3.5 x 3.5</b>	5.0	14.6	11.0	8.7	7.3	10.3	7.7	6.1	5.2
3.5 x 5.5	6.0	35.1	26.3	21.1	17.5	24.7	18.6	14.8	12.4
<b>5.5 x 7.5</b>	7.0	93.1	69.7	55.8	46.5	65.6	49.3	39.4	32.8

**NOTE:** For 1 post, reduce allowable sign areas by 60%.  
 For 3 posts, increase allowable sign areas by 50%.  
 For 3 posts, separate outer posts by more than 8 feet.

**645-3.06 Breakaway Wooden Sign Posts.** Breakaway wooden sign posts shall be installed in accordance with Table 645-2, *Allowable Sign Areas on 2 Breakaway Wooden Posts* and Materials Details.

Each sign stringer to post attachment shall be bolted completely through the post using two 3/8 inch diameter stainless steel bolts with nuts and washers. Posts shall use a concrete foundation as noted in Subsection 645-2.05 in this specification, with a steel tube insert or be backfilled with compacted cushion sand or stone screening, as noted in the Materials Detail Sheets and contract documents.

**645-3.07 Pole-Mounted Sign Support System.** Pole-Mounted Sign Support System, as defined in 645-2.07, shall be firmly attached to the pole in accordance with the standard sheets and/or manufacturer's instructions.

***A. Panels without Z-bar stiffeners:***

Sign panels less than or equal to 18 inches wide, shall be attached to the pole with at least two bands. Sign panels less than or equal to 18 inches wide and longer than 30 inches, shall be attached to the pole with at least three bands.

***B. Panels and assemblies with Z-bar stiffeners:***

Sign panels greater than 18 inches wide and sign panel assemblies shall be banded to the pole at each horizontal Z-bar stiffener, as shown on the standard sheets.

Sign Panels mounted with this type of sign support shall not be greater than 48 inches wide, and shall not be greater than 60 inches in height. Sign panel assemblies mounted with this type of sign support shall not be greater than 48 inches wide.

**645-3.08 Illuminated Signs.** Illuminated sign panels shall be installed as shown in the contract documents. All work on the illumination system shall be performed in accordance with the National Electrical Code and the requirements of the local utility. Electrical circuits shall be tested by the Contractor for insulation resistance and ground resistance in accordance with the requirements below.

Testing equipment shall be supplied by the Contractor and the tests shall be performed in the presence of the Engineer.

**A. Insulation Resistance Test.** Each circuit including ballasts and protective devices shall be insulation tested using an insulation tester according to manufacturers instructions. The Contractor shall compute a polarization index by dividing a ten-minute reading by a one-minute reading. The polarization index shall be greater than 4.0 for acceptance of new circuits, and greater than 2.0 for acceptance of existing circuits. The lighting system shall be properly grounded and disconnected while this test is conducted.

**B. Ground Resistance Test.** A ground test shall be performed by the Contractor using an earth tester with resolution to a minimum of 0.1 ohm. The test shall be performed, and the results interpreted, according to manufacturer's instructions. Readings of 5.0 ohms or less will be required for acceptance.

**C. Functional Test.** After satisfactory completion of all other tests, a functional test shall be performed consisting of not less than ten consecutive days of satisfactory operation. If unsatisfactory performance of any component of the lighting system is discovered during this time, the condition shall be corrected and the Engineer may require the test repeated until ten days of continuous satisfactory operation is obtained.

Temporary shutdowns caused by power interruption or vehicle impact will not constitute discontinuity of the functional test.

**645-3.09 Covering Signs.** (Vacant.)

## **645-4 METHOD OF MEASUREMENT**

**645-4.01 General.** (Vacant)

**645-4.02 Sign Panels.** The work will be measured as the number of square feet measured to the nearest 0.1 square feet of sign panel satisfactorily installed.

The area of each panel will be measured as the area shown on the standard sheets. For sign panels not shown on the standard sheets, the area will be measured as the product of length and width, with no reduction for rounded corners. When sign panels are mounted back-to-back, each panel face will be measured separately.

**A. Panels with Multiple Sheeting types.** Panels with multiple types of sheeting will be measured as the number of square feet measured to the nearest 0.1 square feet for each of the types of sheeting applied to the sign panel. The sum of the all the areas of the sheeting types measured shall equal the total area of the sign panel measured as the product of length and width.

**645-4.03 Type A Sign Posts.** The work will be measured as the number of Type A sign posts required, which is the greater of either:

1. The number of posts required based on the width of the sign; or,
2. The number of posts of standard strength (2100 ft-lbs moment capacity) required to resist the moment due to wind load.

**A. Type A Sign Posts With Extra Embedment.** The work will be measured as the number of Type A sign posts with extra embedment satisfactorily installed with these modified bases.

**B. Soil Plates for Type A Sign Posts.** The work will be measured as the number of soil plates for Type A sign posts satisfactorily installed on either standard Type A sign posts, or on Type A sign posts with extra embedment.

**C. High-Capacity Type A Sign Posts.** The work will be measured as the number of high-capacity Type A sign posts satisfactorily installed. Post systems in which two posts are combined to function as a single post, such as the back-to-back flanged channel or the telescoping square tube, are measured as one post.

**645-4.04 Type B Sign Posts and Rustic Type B Sign Posts.** The work will be measured as the number of Type B sign posts or rustic Type B sign posts satisfactorily installed. When the Engineer directs that a different size Type B sign post be installed at a location that is called for in the contract documents, and there is no contract pay item in the contract for the directed post, the original quantity shall be multiplied by the following factor: lb/ft of directed post divided by lb/ft of original post.

**645-4.05 Concrete Foundations.** The work will be measured as the number of concrete foundations for Type A Sign Posts, or Breakaway Wooden Sign Posts with steel tube inserts satisfactorily installed.

**645-4.06 Breakaway Wooden Sign Posts.** The work will be measured as the number of breakaway wooden sign posts satisfactorily installed.

**645-4.07 Pole-Mounted Sign Support System.** The work will be measured as the number of pole-mounted sign support systems satisfactorily installed.

**645-4.08 Illuminated Sign Panels.** The work will be measured as the number of square feet measured to the nearest 0.1 square feet of illuminated sign panel satisfactorily installed.

**645-4.09 Covering Sign Panels.** (Vacant).

## **645-5 BASIS OF PAYMENT**

**645-5.01 General.** The unit price bid for all items shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work.

**645-5.02 Sign Panels.** The unit price bid for sign panels shall include the panels, sheeting, horizontal and vertical stiffeners (Z-Bars), vertical overhead brackets to mount sign panels to overhead structures, and fasteners and miscellaneous hardware necessary to complete the work. The cost of sign panels that are to become part of larger signs (e.g., route shields on large guide signs) shall be included in the unit price bid for the main panel.

**A. Panels with Multiple Sheeting types.** Panels with multiple types of sheeting will be paid separately under their respective contract pay items.

**645-5.03 Type A Sign Posts.** The unit price bid for Type A sign posts, Type A sign posts with extra embedment, soil plates for Type A sign posts, and high-capacity Type A sign posts shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

**645-5.04 Type B Sign Posts.** The unit price bid for Type B sign posts shall include the posts, breakaway base and hinge assemblies, and concrete footings. Breakaway bases provided in lieu of nonbreakaway posts at the Contractor's option will be paid for at the bid price for nonbreakaway bases.

**645-5.05 Concrete Foundations.** The unit price bid for Concrete Footing for Type A, or Breakaway Wooden Sign Posts with steel tube inserts shall include the cost of furnishing all labor, materials and equipment necessary to install the footing and hardware.

**645-5.06 Breakaway Wooden Sign Posts.** The unit price bid for breakaway wooden sign posts shall include the posts and backfill if required.

**645-5.07 Pole-Mounted Sign Support System.** The unit bid price for each pole-mounted sign support system shall include the cost of furnishing all labor, materials and equipment necessary to install the sign panel or sign panel assembly on a pole, regardless of the number of bands used.

New or relocated sign panels or sign panel assemblies and any required Z-bar stiffeners will be paid under their respective items.

**645-5.08 Illuminated Sign Panels.** The unit price bid for illuminated sign panels shall include the work required under ' 645-5.02 *Sign Panels*, and all luminaires, bulbs, ballasts, wiring, conduit, and fittings from a point just above the footing to the most extreme luminaire. The unit price bid for illuminated sign panels shall also include the cost to energize and test the illuminated sign panel. The cost of energy necessary to illuminate sign panels before final contract acceptance shall be borne by the Contractor. The cost of controllers will be paid separately.

**645-5.09 Covering Sign Panels.** (Vacant.)

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>	
645.5101	Ground-Mounted Sign Panels without Z-bars	Square Foot	
645.5102	Ground-Mounted Sign Panels less than or equal to 32 SF with Z-bars	Square Foot	
645.5103	Ground-Mounted Sign Panels greater than 32 SF with Z-bars	Square Foot	
645.61	Overhead Sign Panels	Square Foot	
645.76	Illuminated Sign Panels	Square Foot	
645.81	Type A Sign Posts	Each	
645.8104	Type A Sign Posts with Extra Embedment	Each	
645.8105	Soil Plate for Type A Sign Post	Each	
645.8106	High-Capacity Type A Sign Posts with Soil Plates Only	Each	
645.8107	Concrete Footing for Type A, or Breakaway Wooden Sign Posts with Steel Tube Inserts	Each	
645.82	Breakaway Wooden Sign Posts	Each	
645.8XXXX	Type B Sign Posts	Each	
<b>X</b>	<b>Appearance</b>	<b>YY Section</b>	
		<b>ZZ Base</b>	
3	Galvanized	01 S3x5.7	01 Nonbreakaway
4	Rustic	02 W6x9	02 BidirectionalBreakaway
		03 W6x12	03 Omnidirectional Breakaway
		04 W8x15	
		05 W10x19	
		06 W10x22	
		07 W12x26	
		08 W14x34	
645.85	Pole-Mounted Sign Support System (Band Mounting)	Each	



## **SECTION 646 - DELINEATORS, REFERENCE MARKERS AND SNOWPLOWING MARKERS**

(Last Revised September 2021)

**646-1 DESCRIPTION.** Furnish and install delineators, reference markers and snowplowing markers in accordance with the MUTCD, contract documents and as directed by the Engineer.

**646-1.01 Delineators.** Delineators are retroreflective sheeting applied to panels mounted on posts or applied to flexible units, which are installed along the highway to serve as driving aids.

**646-1.02 Reference Markers.** Reference markers are panels with a legend, placed at approximately 528 ft. (1/10 mile) intervals along the highway, to provide a numerical location reference.

**646-1.03 Snowplowing Markers and Supplementary Snowplowing Markers.** Snowplowing markers and supplementary snowplowing markers are reflective units installed along the highway to identify guiderail sections for snowplow operators.

### **646-2 MATERIALS.**

Galvanized Coating and Repair Methods	719-01
Aluminum Sign Panels	730-01
Retro-Reflective Sign Sheeting	730-05
Delineator, Reference Marker, and Snowplowing Marker Posts	730-20
Flexible Delineator Posts	730-21
Stiffeners, Overhead Brackets and Miscellaneous Hardware	730-22

**646-2.01 Posts.** Galvanized steel posts as shown on the standard sheets and used for mounting panels.

**646-2.02 Panels.** Panels for backing of retro-reflective sheeting and installed on a post or other structure. Holes may be punched or drilled. Edges shall be smooth and true and free from burrs or ragged breaks. Panels shall be fabricated as shown on the standard sheets.

**646-2.03 Flexible Delineator Posts.** Plastic or other polymer units with retroreflective sheeting applied directly to the surface of the flexible delineator and installed directly along a highway.

### **646-2.04 Retro-Reflective Material.**

**Delineators:** Type: §730-05 NYSDOT Class A sign sheeting  
Colors: Right side - White Left side - Fluorescent Yellow

### **Snowplowing Markers and Supplementary Snowplowing Markers:**

Type: §730-05 NYSDOT Class A sign sheeting  
Colors: Green

### **Reference Markers:**

Type: §730-05.02 NYSDOT Class A sign sheeting  
Colors: White Characters on Green Background

**Note:** Panels supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM Type III/IV and IX retro-reflective sign sheeting, based on the panel type.

**646-2.05 Fasteners.** Stainless steel, galvanized steel or aluminum as shown on the standard sheets.

**646-2.06 Brackets.** Aluminum alloy, galvanized steel or polycarbonate as shown on the standard sheets.

**646-2.07 Corrosion Protection.** Provide and use either an approved mastic or 1/8 inch thick plastic pad placed between aluminum and steel to prevent dissimilar metals from coming in direct contact with each other.

### **646-3 CONSTRUCTION DETAILS**

**646-3.01 Fabrication.** Fabricate delineators, reference markers and snowplowing markers as shown on the standard sheets using approved materials. Use the same type of sign sheeting on all panels within a project. Apply characters to reference markers as specified in §645-2.02 E. Sign Sheeting Characters, and as shown on the Contract Documents.

**646-3.02 Location.** Install at the locations and spacing as shown on the contract documents or as ordered by the Engineer. Directional orientation, arrangement, number, and color of reflector units, at any given location shall be as shown on the contract documents.

Install reference markers at approximately 528 ft (1/10 mile) intervals along the highway on new construction, at existing locations for replacement units, or as ordered by the Engineer. The Contractor will be given the location of each marker.

Install snowplowing markers and supplementary snowplowing markers at the locations shown on the Contract Documents or as ordered by the Engineer.

**646-3.03 Installation.** Install flexible delineator posts as per the manufacturer's recommendations and as directed by the Engineer.

Delineators, reference markers and snowplowing markers are to be erected on posts, brackets, existing posts, and structures in the manner shown on the standard sheets.

Install delineator, reference marker and snowplowing/supplemental snowplowing marker panels on posts, brackets, existing posts, and structures in the manner shown on the standard sheets.

#### **646-3.04 Inspection.**

After the installation of delineators, reference markers and snowplowing/supplemental snowplowing markers, an inspection by the Engineer will be made in the daytime to confirm proper location, line and grade, vertical post alignment and visibility. The Engineer will also carry out a nighttime inspection to confirm proper orientation and to check for inconsistent or lack of retro-reflection and other defects more conspicuous at night. All problems and defects noted after the day and night inspections shall be corrected by the Contractor to the satisfaction of the Engineer at no additional cost to the State

**646-3.05 Damage.** When delineators and markers are installed on walls, bridges, existing posts, poles or structures, care shall be taken to not damage the appearance or structural features of the existing facilities. All damaged features shall be repaired or replaced, at no additional cost, to the satisfaction of the Engineer.

**646-3.06 Panel Relocation.** Carefully remove panels to be relocated and stockpile them in a safe above ground location as shown in the contract documents or at a location satisfactory to the Engineer. Protect the panels, including the retroreflective sheeting, from damage. Replace all damaged panels at no cost to the State. Remove and dispose of all existing posts and/or hardware used only for the support of the existing panels.

Removed posts shall become the property of the Contractor and shall be removed from the work site in a neat manner.

Re-erect relocated panels on new posts, brackets, or bands at the locations specified in the contract documents or as directed by the Engineer.

**646-4 METHOD OF MEASUREMENT.** Delineators, reference markers, snowplowing markers, supplementary snowplowing markers, flexible delineator posts, posts and brackets will be measured as the number of complete panels, brackets and posts installed. In the event a section of highway is under construction by others and reference markers cannot be installed, they will be measured as the number of marker panels and posts furnished only. Relocated panels will be measured as the number of panels relocated.

**646-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of all materials, equipment, and labor necessary to satisfactorily complete the work. Cost of mounting hardware will be included with the cost of the panels.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
646.21	Reference Marker Panel	Each
646.22	Delineator, Snowplowing Marker, Supplementary Snowplowing Marker Panels	Each
646.23	Large Delineator, Large Snowplowing Marker, Large Supplementary Snowplowing Marker Panel	Each
646.24	Reference Marker, Delineator, Snowplowing Marker, Supplementary Snowplowing Marker Panels Relocation	Each
646.31	Steel Post, 1.1 lb/ft	Each
646.32	Steel Post, 2.0 lb/ft	Each
646.40	Flexible Delineator, Single Unit, One Way	Each
646.41	Flexible Delineator, Single Unit, Back to Back	Each
646.42	Flexible Delineator, Double Unit	Each
646.50	Brackets for Barrier and Multidirectional Mounting	Each

**SECTION 647 - REMOVING, STORING, AND RELOCATING SIGNS, SIGN PANEL ASSEMBLIES, SIGN SUPPORTS, AND FOUNDATIONS**

**647-1 DESCRIPTION.** This work shall consist of removing and disposing, storing, and relocating individual sign panels, sign panel assemblies, sign supports, and sign support foundations.

**647-1.01 Definition.** Sign Panel Assembly – a group of contiguous sign panels attached by means of bars, on the same sign support(s).

**647-2 MATERIALS.** All new materials used shall comply with the requirements of §644, or 645 as applicable.

## 647-3 CONSTRUCTION DETAILS

**647-3.01 General.** Sign panels, sign panel assemblies, sign supports, and sign support foundations shall be removed, stored, or relocated in accordance with the contract documents, standard sheets, MUTCD and materials details. Sign locations in the contract documents are approximate.

**647-3.02 Remove and Dispose Overhead Sign Structures.** Removal of overhead sign structures shall be done in accordance with §644-3.06 A.

Lifting of overhead sign structures shall be done in accordance with §107-05P. *Lifting*. Lift Plans are required.

No lifting shall be permitted over traffic.

Designated sign structures and any attached pole-mounted sign panel assemblies or overhead signs requiring disposal, but not relocation or storage, shall become the property of the Contractor and shall be removed from the work site.

All concrete sign footings shall be removed to a minimum depth of 1 foot below existing ground and shall be restored to match the surrounding area to the satisfaction of the engineer.

Any work to relocate or remove and store existing sign panels from the overhead sign structure is performed under a separate item.

**647-3.03 Relocate Overhead Sign Panel, Sign Panel Assembly.** Overhead sign panels or sign panel assemblies shall be removed from the overhead sign structure by removing the bolts or other attachment device from the structure. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers or stiffeners. Any part damaged by the Contractor's operations shall be replaced by the Contractor at no additional cost to the State. Signs, sign panel assemblies shall be reinstalled in accordance with §645-.3. All hardware, steel angles, and bearing pads needed to reattach the sign panel, sign panel assembly to the relocated sign shall be new. Existing stringers and stiffeners shall remain attached to the sign panel(s).

**647-3.04 Remove and Store Overhead Sign Panel, Sign Panel Assembly.** Overhead sign panels or sign panel assemblies shall be removed from the existing overhead structure by removing the bolts or other attachment device from the support structure. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers, structure or stiffeners. Signs shall be transported to the storage location(s) identified in the contract documents. Any part damaged by the Contractor's operations shall be replaced by the Contractor at no additional cost to the State.

**647-3.05 Remove and Dispose Overhead Sign Panel, Sign Panel Assembly.** Overhead sign panels or sign panel assemblies shall be removed from the site and shall become the property of the contractor. Care shall be exercised to prevent damage to the sign structure or sign supports.

**647-3.06 Relocation of Ground-Mounted Sign Panel, Sign Panel Assembly** Ground-mounted sign panels, sign panel assemblies shall be detached from the support structure or posts by removing the bolts or other attachment device from the support structure or posts. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers or stiffeners. The existing stringers and stiffeners shall remain attached to the sign panel(s). Any part damaged by the Contractor's operations shall be replaced by the Contractor at no additional cost to the State. Signs, sign panel assemblies shall be reinstalled in accordance with §645-3 on new posts and foundations. All hardware used to attach the sign panel(s), sign panel assembly to the post(s) shall be new.

**647-3.07 Remove and Store Ground-Mounted Sign Panel, Sign Panel Assembly.** Ground-mounted sign panels, sign panel assemblies shall be detached from the support structure or posts by removing the bolts or other attachment device from the support structure or posts. Care shall be exercised in removing the sign, sign panel assembly to prevent damage to any part of the reflectorized sign face or characters and to the existing stringers or stiffeners. Care shall also be exercised to avoid damage to any structures or supports that will not be removed. Signs shall be transported to the storage location(s) identified in the contract documents. Any part damaged by the Contractor's operations shall be replaced by the Contractor at no additional cost to the State.

**647-3.08 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly.** Existing ground-mounted sign panels, sign panel assemblies shall be detached from the posts by removing the bolts or other attachment device from the posts. Ground-mounted sign panels, sign panel assemblies shall be removed from the site and become the property of the contractor. Care shall be exercised to prevent damage to the sign structure or sign supports.

**647-3.09 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly, Type A Sign Supports and Foundations.** Existing ground-mounted sign panels, sign panel assemblies and/or Type A sign supports shall be removed from the site and become the property of the contractor. Type A sign post foundations shall be completely removed. The disturbed area shall be restored to match the surrounding area to the satisfaction of the Engineer.

**647-3.10 Remove and Dispose High-Capacity Type A and Type B Ground-Mounted Sign Supports and Foundations.** Existing ground-mounted sign supports and/or foundations shall be removed from the site and become the property of the Contractor. High-Capacity Type A sign post foundations shall be completely removed. Type B footings shall either be completely removed or shall be cut to a depth of at least 1 foot below existing ground. Backfilling and surfacing shall be performed to match the surrounding area to the satisfaction of the Engineer.

#### **647-4 METHOD OF MEASUREMENT.**

**647-4.01 General.** The size of sign panels, sign panel assemblies shall be measured as the product of overall width and height equaling a number of square feet and rounded to the nearest square foot.

Overall width for sign panel assemblies shall be measured as the total width neglecting spaces between sign panels.

Vertical spaces less than one foot between panels, or sign panel assemblies shall be included in the calculation of overall height. For vertical spaces one foot or more, the panel, sign panel assembly heights shall be measured separately. The total area shall be the sum of the individual areas measured.

When ground-mounted sign panels, sign panel assemblies are mounted back to back, only the larger side shall be measured when the entire structure is to be removed. When one or both of two back to back panels are relocated or removed and stored, separate panel measurements shall be made.

**647-4.02 Remove and Dispose Overhead Sign Structures.** The work will be measured as the number of overhead sign structures completely removed and disposed, including any overhead sign panels that are also to be removed and disposed.

**647-4.03 Relocate Overhead Sign Panel, Sign Panel Assembly.** The work will be measured as the number of overhead sign panels, sign panel assemblies relocated.

**647-4.04 Remove and Store Overhead Sign Panel, Sign Panel Assembly.** The work will be measured as the number of overhead sign panels, sign panel assemblies removed and stored.

**647-4.05 Remove and Dispose Overhead Sign Panel, Sign Panel Assembly.** The work will be measured as the number of overhead sign panels, sign panel assemblies removed and disposed from structures or supports that will not be removed.

**647-4.06 Relocation of Ground-Mounted Sign Panel, Sign Panel Assembly.** The work will be measured as the number of ground-mounted sign panels, sign panel assemblies relocated.

**647-4.07 Remove and Store Ground-Mounted Sign Panel, Sign Panel Assembly.** The work will be measured as the number of ground-mounted sign panels, sign panel assemblies removed and stored.

**647-4.08 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly.** The work will be measured as the number of ground-mounted sign panels, sign panel assemblies removed and disposed.

**647-4.09 Remove and Dispose Ground-Mounted Sign Panel, Sign Panel Assembly, Type A Sign Supports and Foundations.** The work will be measured as the number of ground-mounted sign panels, sign panel assemblies and foundations removed and disposed.

**647-4.10 Remove and Dispose High-Capacity Type A and Type B Ground-Mounted Sign Supports and Foundations.** The work will be measured as the number of ground-mounted sign supports and foundations removed and disposed.

**647-5 BASIS OF PAYMENT.** The unit price bid for removing, storing, and relocating signs shall be compensation in full for the furnishing of all labor, equipment and materials necessary to complete the work.

No additional payment will be made for the restoration of surfaces when foundations are removed.

Payment for new sign supports, and foundations will be made under separate pay items.

*Payment will be made under:*

<b>Item No.</b>	<b>Item Pay</b>	<b>Unit</b>
647.20	Removal of Cantilever Overhead Sign Panel(s), Structure, and Foundations	Each
647.21	Removal of Single Span Overhead Sign Panel(s), Structure, and Foundations	Each
647.22	Removal of Multi-Span Overhead Sign Panel(s), Structure, and Foundations	Each
647.23	Relocate Overhead Sign Panel, Sign Panel Assembly	Each
647.24	Remove and Store Overhead Sign Panel, Sign Panel Assembly	Each
647.25	Remove and Dispose Overhead Sign Panel, Sign Panel Assembly	Each
647.31	Relocate Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)	Each
647.32	Relocate Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)	Each
647.33	Relocate Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)	Each
647.41	Remove and Store Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)	Each
647.42	Remove and Store Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)	Each
647.43	Remove and Store Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)	Each
647.51	Remove and Dispose Sign Panel, Sign Panel Assembly Size I (Under 30 Square Feet)	Each
647.52	Remove and Dispose Sign Panel, Sign Panel Assembly Size II (30-100 Square Feet)	Each
647.53	Remove and Dispose Sign Panel, Sign Panel Assembly Size III (Over 100 Square Feet)	Each
647.61	Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations - Size I (Under 30 Square Feet)	Each
647.62	Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations - Size II (30-100 Square Feet)	Each
647.63	Remove and Dispose Signs, Ground Mounted Type A Sign Supports and Foundations - Size III (Over 100 Square Feet)	Each

647.64	Remove and Dispose High Capacity Type A Ground Mounted Sign Support and Foundation	Each
647.65	Remove and Dispose Type B Ground Mounted Sign Support and Foundation	Each

## SECTION 648 - SUBSURFACE EXPLORATIONS

**648-1 DESCRIPTION.** This work shall consist of furnishing equipment, drilling for soil and rock samples, and preparing a driller's log in accordance with these specifications and the direction of the Engineer.

**648-2 MATERIALS.** Materials for this work shall meet the requirements of the following Subsections of Section 700 - Materials and Manufacturing:

Drill Rigs	732-01
Drive Pipe	732-02
Casing	732-03
Samplers	732-04
Thin-Walled Sample Tubes	732-05
Coring Bits	732-06
Sample Storage Bags	732-07
Sample Jars	732-08
Jar Cartons	732-09
Boulder and Rock Core Boxes	732-10
Open Well Piezometers	732-11
Grout	732-12

### 648-3 CONSTRUCTION DETAILS

**648-3.01 General.** This work shall consist of furnishing equipment, clearing of all drill holes in accordance with New York State Department of Public Service Rule 753, drilling for soil and rock samples, back filling all drill holes to the satisfaction of the Engineer, and preparing a driller's log in accordance with these specifications. Any proposed variation from the methods and techniques in the specifications shall be submitted in writing by the Contractor to the Engineer who shall forward the proposal to the Director of the Geotechnical Engineering Bureau for review. Approval, if granted, will be based on the decision of the Director of the Geotechnical Engineering Bureau as to the capabilities of the proposed variation to provide satisfactory samples and subsurface information. If granted, this approval will remain in force only so long as all conditions set forth in the approval are met and satisfactory results are obtained. In the event unsatisfactory results are obtained, the approval will be withdrawn and all remaining work shall be completed in accordance with this specification. Boring work shall not commence until all equipment stated in the proposal is on the project and approved. In addition, the following shall apply:

**A. Furnishing Equipment for Making Borings.** The Contractor shall furnish the number of drill rigs, conforming to §732-01, stated in the proposal or work order, maintain this equipment, and remove it from the site at the time indicated by the Engineer. All equipment shall be acceptable to the Engineer.

**B. Driller's Logs.** The forms for the driller's logs, Form 282e, will be furnished by the State and shall have the following information legibly printed on them by the Contractor:

Region  
County

Contractor Name  
Contract Number  
Project Identification Number (PIN)  
Project Name  
Date Started and Finished  
Hole Number  
Weight and Fall of Hammer (Casing)  
Weight and Fall of Hammer (Sampler)  
Casing and Sampler Size  
Inspector Name (Regional Geotechnical Engineer on Log)  
Structure Name/Number  
Penetration Records (Blows on Casing, Drive Pipe and Sampler)  
Sample numbers

Groundwater Data

Depth at which drill water was first used  
Depth at which groundwater was first encountered  
Depth to groundwater at the beginning and end of each day's operation

Rock Core

Length of Run  
Percent Recovery  
Number of Pieces  
Depth Core Obtained  
Size of Core Obtained  
Type of Core Barrel

All pertinent remarks and comments

The hole designation on the final log and sample containers should reflect the actual method of progressing the hole. Any change in hole designation (due to an alternate hole progression method) shall be forwarded to the Engineer in writing in a timely manner.

Provide all measurements and dimensions in U.S. Customary units on the final log.

Ensure that the completed driller's log is signed by the drill rig operator, the drill rig inspector, and the Chief Inspector.

Deliver the samples and a copy of the completed driller's log to the location indicated in the Contract documents, between the hours of 8:00 A.M. and 3:00 P.M., within five working days following completion of the hole, except holidays. In addition, deliver another copy of the completed driller's log to the Departmental Geotechnical Engineer. Submit the original copy of the completed driller's log to the Engineer.

**C. Groundwater Determinations.** The level at which groundwater is first encountered in the borings shall be noted. Water level readings shall be taken at the end of each day after the last sample has been taken and the sample and rods have been removed. No soil shall be left in the casing at the end of the day. Do not fill the casing with water unless there is a need to compensate for a condition such as running sand. Measure and record the change in water level when resuming work. Capped borings shall be vented. Groundwater levels shall be measured before and after the casing or drive pipe is pulled. Each water level reading shall be recorded showing the date and time the reading was made, the depth of the drive pipe or casing, and the depth to water. Any loss or gain of water in the boring, except that caused by deliberately introducing water and/or inserting or removing tools, shall be



recorded. This record shall show the date and time the loss or gain is noted, the depth of the casing and the depth to water. The height of artesian rise shall be recorded.

All water level readings and related data shall be recorded on the boring logs under "Remarks". If necessary, additional forms shall be used for recording groundwater data.

Artesian pressures shall be permanently sealed at the elevation at which they were encountered. This seal shall be satisfactory to the Engineer before casing is removed from the hole.

### **648-3.02 Split Barrel Samples**

**A. Progressing the Hole.** The hole shall be progressed by advancing flush-joint casing, flush-coupled casing, or extra-strength drive pipe by driving or drilling, or where permitted, by a drilling mud process or by using a hollow flight auger. When driven casing is used a 300-lb ( $\pm$  3 percent) hammer falling freely 18 inches shall be used. Actuate the hammer by means of a rope and cathead, or by automatic hammer, when casing or drive pipe is driven.

Casing refusal shall be considered as 300 blows for less than 12 inches of penetration. When refusal is encountered, the casing shall be cleaned and a sample shall be attempted, if no sample is recovered, coring will commence.

Prior to sampling, the drill hole shall be cleaned to the sampling elevation by using equipment that will not disturb the material to be sampled. Bottom discharge bits, including samplers, will not be allowed. A roller bit may be used as a clean out tool if it is of a type that deflects water to the sides rather than downward into the material to be sampled. The Engineer may order a new roller bit at any time he deems the one in use to be unacceptable. "N" size drill rods or larger shall be used in 3 inch or larger inside diameter casing.

The Engineer shall be advised of the time of the last sampling operation so he may be present when the hole is measured for payment purposes.

**B. Sampling.** Samples shall be taken at every change in stratum, but in no case at intervals greater than 5 feet. Continuous sampling may be directed by the Engineer. The sampler shall be placed on the bottom of the cleaned out hole and then driven 18 inches with a 300-lb ( $\pm$  3 percent) hammer falling freely 18 inches. Actuate the hammer by means of a rope and cathead, or by automatic hammer. When the Standard Penetration Test (SPT) is required, use equipment and procedures conforming to ASTM D1586-84, except as modified by this specification.

The number of blows required to drive the sampler each increment of 6 inches shall be recorded. If refusal is encountered before the desired sample length is attained, and the sampler proves to have no recovery, the sampler shall be removed from the hole and core drilling started; however, if refusal is encountered and the material retained represents the best obtainable sample as determined by the Engineer, the hole may be progressed to the next sample elevation or change in soil strata. Refusal shall be 50 hammer blows for less than 6 inches of penetration for the 300-lb hammer. When the SPT is used, refusal shall be as defined in ASTM D1586-84.

When a recovery of less than 6 inches of sample in a split barrel sampler is retrieved, the sampler shall be re-driven at the same elevation in an attempt to obtain more material. Only the first set of blows shall be recorded on the boring log, but a note shall be included under "Remarks" indicating that a second sampling attempt was made. The Engineer may direct that a basket or other spring type retainer be used on any or all sampling attempts. Flap or trap valves will only be used when specifically directed by the Engineer. When sampling material below the water table, the hole shall be kept full of fluid during the removal of tools to prevent flowback, unless otherwise directed by the Engineer.

All samples, regardless of the amount of recovery, shall become the property of the State and shall be packaged, transported and delivered in accordance with this specification.

**C. Marking, Packaging and Transporting Sample.** Samples shall be placed in tied plastic storage bags placed in jars conforming to §732-08 in such a manner so as to maintain the natural structure of the sample. The jar shall be labeled to show the project name, PIN, sample number, hole number, and the depths from which the sample was taken. Jars shall be placed in cartons conforming to §732-09. Samples must be protected from freezing or extreme heat. The samples shall be delivered by the Contractor to the location indicated in the Contract documents between the hours of 8:00 A.M. and 3:00 P.M., within five working days following completion of the hole, excepting holidays.

If samples are not delivered in a timely manner, work will be suspended until the samples have been delivered as required by the contract.

**D. Acceptance.** Samples having less than 6 inches of recovery or more than 2 inches of wash material will be considered unacceptable unless, in the judgment of the Engineer, the actual recovery represents the best sample obtainable. All samples shall become the property of the State.

### **648-3.03 Thin-Walled Tube Samples**

**A. Progressing the Hole.** The hole shall be a minimum of 4 inches in diameter. Drilling mud may be used if permitted in writing by the Engineer. Hollow stem augers will not be allowed. The hole shall be cleaned using methods and equipment which will not disturb the soil to be sampled. Bottom discharge bits, including samplers, will not be allowed.

The 2 inches of soil directly above the sampling elevation shall be removed with a clean-out jet auger without the use of water. “N” size drill rod or larger shall be used.

**B. Sampling.** Thin-walled tube samples shall be taken in the strata designated by the Engineer. Samples shall be recovered with a stationary piston type sampler or a hydraulically operated piston sampler, modified to accept the thin-walled tubes specified in §732-05. Samplers with piston rods extending to the ground surface must be provided with clamps which positively lock the piston against upward travel during lowering of the sampler until the sampling depth is reached. During the press the piston rods shall be locked in a stationary position to eliminate any movements either up or down. In addition, the sampler shall also be provided with positive locks to secure the piston rods prior to removal of the sampler after penetration.

At the elevation to be sampled, the tube shall be pressed into the soil with a continuous motion a distance of 18 inches. Care must be taken to allow air and water to flow freely through the vent thus preventing compression of the soil sample. After pressing to the required depth and waiting for 5 minutes, the sampler shall be carefully rotated and removed from the hole.

During the removal of the sampler the hole shall be kept full of fluid. Before the thin-walled tube is removed from the piston, the piston rod shall be backed off to admit air past the flattened threads to break the vacuum. For other approved types of equipment, the necessary vacuum breaking measures shall be taken. The length of sample in the tube and also the distance pressed, shall be measured and recorded.

Should a thin-walled sample not be retained, a 2 inch driven sample shall be taken.

The bottom of the sample shall be carefully squared off at least 1 inch back from the end of the tube and a wax seal, approximately 1 inch thick, shall be poured in the bottom end of the tube. The soil at the top of the tube shall be carefully squared off and a wax seal, approximately 1/2 inch thick, shall be poured. Any space remaining between the top or bottom of the sample tube and the wax seal shall be filled with sawdust or paper after the wax has hardened. Wax will be furnished by the Geotechnical Engineering Bureau. The ends of the tubes shall be sealed with snugly fitting plastic caps which shall be secured in place with friction tape. Wax shall not be placed on the outside of the tube. Labels shall be placed on the tube below center and secured with strips of tape.

**C. Marking, Packaging and Transporting Samples.** Thin-walled tubes shall be labeled to show the Project Identification Number, Location, hole number, sample number, and depths from which the sample was taken. The samples shall be handled, stored and transported using care to prevent the samples from being subjected to freezing, drying, jarring and any other disturbance. The tubes properly packaged shall be stored and transported in an upright position at all times. The tubes shall be delivered by the Contractor to:

New York State Department of Transportation  
Laboratories  
State Campus, Building 7  
1220 Washington Avenue  
Albany, New York 12206

between the hours of 8:00 A.M. and 3:00 P.M., within five working days after obtaining the tubes, excepting holidays.

**D. Acceptance.** Thin-walled tubes having less than 12 inches of undisturbed recovery will be unacceptable for payment unless in the judgment of the Engineer, based on a recommendation by the Director of the Geotechnical Engineering Bureau, the actual recovery represents the best available. Thin-walled tubes which have been frozen will be unacceptable for payment. Samples that are not taken in accordance with the specification, or that are not properly sealed, or transported may be rejected.

#### **648-3.04 Rock Core Samples**

**A. Progressing the Hole.** The hole shall be progressed through the overburden in accordance with §648-3.02A until refusal is encountered. Continuous core drilling shall then be progressed in boulders and ledge rock at locations and to depths determined by the Engineer.

**B. Sampling.** Core shall be drilled using a double tube, swivel type core barrel. If at any time the core barrel is withdrawn more than 1 1/4 inches, the core barrel shall be removed from the hole and the core removed from the barrel.

**C. Marking, Packaging and Transporting Samples.** Rock cores shall be labeled in accordance with the current Geotechnical Engineering Bureau Drawing entitled "Proper Labeling of Rock Cores." They shall be placed in core boxes constructed in accordance with the current Geotechnical Engineering Bureau Drawing entitled "Core Box - AX, BX, HX, NX Sizes" and delivered to the Department's Regional Office or to a location designated in the proposal within two weeks after completion of the hole.

**D. Acceptance.** Rock core recoveries of less than 85 percent of each run will be considered unacceptable unless, in the judgment of the Engineer, all obtainable state-of-the-art equipment and methods have been used and actual recovery represents the best obtainable.

#### **648-3.05 Open Well Piezometer**

**A. Progressing the Hole.** A 4 inch nominal diameter cased drill hole shall be progressed to the depth specified on the contract documents. Equipment conforming to the requirements contained in §732-01 shall be used.

**B. Installing the Well Pipe.** The open well piezometer shall be assembled to form a continuous pipe as recommended by the manufacturer or as directed by the Engineer. The open well piezometer shall be placed in the hole as shown in the Open Well Piezometer drawing to the elevation or depth specified in the contract documents or as directed by the Engineer. No grout, debris or other foreign material shall enter the PVC pipe during the installation.

**C. (Vacant)**

**D. Placing the Bentonite Seal.** After the final sand placement the steel casing shall be withdrawn an additional 12 inches. and the bentonite pellets placed to form a 12 inch thick seal.

**E. Grouting and Casing Removal.** The hole shall be grouted from the bottom using the mix found at the end of this subsection or in proportions approved by the Engineer. The contractor shall withdraw the casing. As the casing is being withdrawn, the level of grout shall be maintained within 5 feet of the top of the hole at all times. The PVC pipe shall not be allowed to move vertically while withdrawing the casing.

COMPONENT	NYSDOT SPECIFICATION REQ.	PROPORTION BY VOL.
PORTLAND CEMENT TYPE 1 OR 2	§701-01	2 PARTS
WATER	§712-01	12 PARTS
BENTONITE (ground to pass a No. 200 sieve)	N/A	1 PART

**F. Finishing.** Wait 18 hours for the grout to cure. If the grout bleeds or shrinks, the hole shall be backfilled with sand to within 12 inches of the top of the hole. The manhole shall be mortared over the top of the open well piezometer as shown in Open Well Piezometer drawing.

**648-3.06 Bore Hole Grouting.** Prior to placing the grout, the sides of the boring shall be supported to the satisfaction of the Engineer using casing or some other positive means. The Contractor shall mix the grout in the following proportions, by volume:

BENTONITE	1 PART
DRY CEMENT	12 PARTS
WATER	18 PARTS

or in proportions approved by the Engineer. After the boring is cleaned out, a grout pipe shall be placed to the bottom of the hole and grout pumped through the pipe to completely fill the boring for the full depth of the boring. After grouting, the casing shall be removed, and the boring topped off with grout. All mixing and placing operations shall be performed to the satisfaction of the Engineer.

#### 648-4 METHOD OF MEASUREMENT

**648-4.01 Furnishing Equipment for Making Borings.** The quantities to be paid for will be the number of drill rigs, including barges, platforms and support vessels where required on water, specified in the

proposal or work order, and for additional drill rigs ordered on the project by the Engineer. Payment will not be made for any drill rig that does not work at least 75 percent of the total working time computed from the date of actual commencement of the work to the final completion date, except for additional drill rigs ordered to the project by the Engineer.

**648-4.02 Split Barrel Sample.** The quantity to be paid for will be the number of acceptable samples obtained.

**648-4.03 Thin-Walled Tube Sample.** The quantity to be paid for will be the number of acceptable samples obtained.

**648-4.04 Rock Core Drilling.** The quantity to be paid for will be the number of linear feet drilled from which acceptable core was obtained. Measurement for payment shall be made in the presence of the Engineer.

**648-4.05 Drill Hole (2 1/2 inch and 4 inch diameter).** The quantity to be paid for will be the number of linear feet of boring progressed in overburden, less a deduction equal to the specified sampling interval for each unacceptable sample. Measurement shall be made from the surface elevation where the boring starts (including top of bridge deck or the water surface if working from a floating platform) at each hole. Measurement for payment shall be made in the presence of the Engineer.

**648-4.06 Open Well Piezometer.** The quantity to be paid for will be the number of linear feet of PVC pipe satisfactorily installed in accordance with this specification, measured from the top of the pipe to the bottom of the slotted screen.

**648-4.07 Bore Hole Grouting (2 1/2 inch and 4 inch diameter).** The quantity to be paid for will be the number of linear feet of drill hole grouted in accordance with these specifications.

## **648-5 BASIS OF PAYMENT**

**648-5.01 Furnishing Equipment for Making Borings (on land or water).** The unit price bid for each drill rig shall include the cost of all labor, materials and equipment including barges, platforms and support vessels necessary to furnish, transport and maintain the drill rig, and dismantling and removing the equipment.

**648-5.02 Split Barrel Sample.** The unit price bid per sample shall include the cost of all labor, material and equipment necessary to obtain, mark, package and deliver the sample. The jars, cartons and samples shall become the property of the State.

**648-5.03 Thin-Walled Tube Sample.** The unit price bid per sample shall include the cost of all labor, materials and equipment necessary to obtain, mark, package and deliver the sample. The tubes and samples shall become the property of the State.

**648-5.04 Rock Core Drilling.** The unit price bid per foot shall include the cost of all labor, material and equipment necessary to obtain, mark, package and deliver the samples. The core boxes shall become the property of the State.

**648-5.05 Drill Hole (2 1/2 inch and 4 inch diameter).** The unit price bid per foot shall include the cost of all labor, clearing of all drill holes in accordance to New York State Department of Public Service Rule 753, and material and equipment used to progress the hole from which an acceptable sample or samples

were obtained and acceptably recorded on a driller's log. The unit price bid shall be based on 50 foot incremental depths as follows:

0 - 50 feet      50 - 100 feet      100 - 150 feet      150 - 200 feet      over 200 feet

**648-5.06 Open Well Piezometer.** The unit price bid for this item shall include the cost of all labor, materials and equipment necessary to satisfactorily install and protect the open well piezometer. The Contractor will receive full payment after the open well piezometer has been approved by the Engineer.

**648-5.07 Bore Hole Grouting (2 1/2 inch and 4 inch diameter).** The unit price bid for grouting borings shall include the cost of furnishing all labor, materials and equipment necessary to complete the work as required by these specifications. The cost for progressing the boring will be paid under its appropriate item.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
648.01	Drill Hole, 2 1/2 inch diameter 0 to 50 feet Depth Range	Foot
648.02	Drill Hole, 2 1/2 inch diameter 50 to 100 feet Depth Range	Foot
648.03	Drill Hole, 2 1/2 inch diameter 100 to 150 feet Depth Range	Foot
648.04	Drill Hole, 2 1/2 inch diameter 150 to 200 feet Depth Range	Foot
648.05	Drill Hole, 2 1/2 inch diameter greater than 200 feet Depth Range	Foot
648.06	Drill Hole, 4 inch diameter 0 to 50 feet Depth Range	Foot
648.07	Drill Hole, 4 inch diameter 50 to 100 feet Depth Range	Foot
648.08	Drill Hole, 4 inch diameter 100 to 150 feet Depth Range	Foot
648.09	Drill Hole, 4 inch diameter 150 to 200 feet Depth Range	Foot
648.10	Drill Hole, 4 inch diameter greater than 200 feet Depth Range	Foot
648.11	Split Barrel Sample	Each
648.12	Thin-Walled Tube Sample	Each
648.13	Rock Core Drilling AX	Foot
648.14	Rock Core Drilling BX	Foot
648.15	Rock Core Drilling NX	Foot
648.16	Rock Core Drilling HX	Foot
648.17	Furnishing Equipment for making Borings	Each
648.18	Furnishing Equipment for making Borings on water	Each
648.19	Furn. Equip. for making Borings on water using stationary platform	Each
648.20	Open Well Piezometer	Foot
648.21	Grouting 2 1/2 inch Bore Hole	Foot
648.22	Grouting 4 inch Bore Hole	Foot

**SECTION 649 - AUDIBLE ROADWAY DELINEATORS**

(Last Revised January, 2017)

**649-1 DESCRIPTION.** Audible delineators are depressions placed on the road surface to serve as driving aids. This work shall consist of installing audible roadway delineators where indicated on the contract documents.

**649-2 MATERIALS.** None specified.

**649-3 CONSTRUCTION DETAILS**

**Milled-In Audible Roadway Delineators (MIARDs).**

**A. Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the MIARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work on asphalt shoulders, the Contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt to be milled.

The cutting head shall be on its own suspension system, independent from that of the power unit, to allow the head to align itself with the slope of the shoulder and/or any irregularities in the shoulder surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each MIARD at the offsets from traveled way indicated on the project plans. Where directed by the Plans or EIC to mill in MIARDs in areas marked with crosshatching, the spacing of the MIARDs shall be adjusted to minimize damage to the markings. No milling shall be done within 4 inches of transverse joints.

**B. Installation and Dimensions.** The finished MIARDs shall conform to the dimensions and spacing shown on the Standard Sheets. The milling machine shall be capable of grinding to within 3 feet of an obstruction. The offset from traveled way may be changed at the EIC's discretion.

At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The pavement shall be cleaned by sweeping and the work area shall be reopened to traffic. The milled material shall be thoroughly removed from the shoulders. In uncurbed areas, the millings may be swept off the shoulder to serve as shoulder back-up material. In curbed areas, millings shall be removed from the project and disposed of in an acceptable manner.

#### **Centerline Audible Roadway Delineators (CARDs).**

**A. Scheduling and Coordination.** Because of the need to promptly replace pavement markings and reopen the highway to traffic, milling of CARDs shall not be conducted when conditions would not allow pavement markings to be placed soon after. To facilitate prompt placement of pavement markings by either the Department's pavement marking crews or the Contractor as indicated in the contract documents, all work shall be done between April 1 and November 30 Downstate (in the counties of Dutchess, Orange, Rockland, Putnam, Westchester, Nassau, Suffolk, and the City of New York) and between May 1 and October 31 Upstate (all other counties). If the contract documents indicate that pavement markings will be installed by the Department, the Contractor shall inform the Engineer of the planned work schedule and the Engineer will coordinate with the Department's pavement marking crew chief. If the contract documents indicate that pavement markings will be installed by the Contractor, pavement markings shall be installed within three calendar days, measuring from the date on which the markings at that point were first removed. Gaps: Prior to milling, the Contractor shall obtain EIC approval on where CARDs are to be installed and where gaps are to be included.

**B. Timing of CARD Placements.** New asphalt pavement should be allowed to harden for at least 24 hours before CARDs are milled in, so that the milling machine does not tear the asphalt and so that asphalt does not build up on the cutters. Temporary Pavement Markings, in conformance with Section 619-3.06, shall be installed during this hardening period. If tape is used, it shall be removed before milling commences. After the CARDs have been milled and the millings have been removed, the permanent pavement markings can be installed.

- C. Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the CARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work, the contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt.

The cutting head shall be on its own suspension system, independent from that of the power unit, to allow the head to align itself with the slope of the pavement and/or any irregularities in the surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each CARD relative to the centerline markings.

- D. Installation and Dimensions.** The Contractor shall provide Work Zone Traffic Control as indicated in the contract documents.

CARDs shall be installed within the limits indicated in the contract documents. Unless indicated otherwise in the contract documents, CARDs shall be centered on the middle of the centerline marking pattern. No milling shall be done within 4 inches of sawn and sealed transverse joints. CARDs shall not be carried through any intersection where the CARD's direction of travel is controlled by a yield sign, stop sign, or traffic light, or would encounter crosswalks. In those instances, the CARD shall stop before any stop line or crosswalk. CARDs shall not be carried through any crosswalks or across any concrete bridge deck or concrete culvert surface. Treatment for left turn lanes shall be as shown on the Standard Sheets.

At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The pavement shall be cleaned by sweeping and the work area shall be reopened to traffic. Millings shall be thoroughly removed from the work area and disposed of in an acceptable manner.

### **Secondary Highway Audible Roadway Delineators (SHARDs).**

- A. Equipment.** The construction equipment shall include a rotary type cutting head capable of cutting the SHARD depressions to the dimensions and at the spacing indicated on the Standard Sheets. The pattern of cutting tips on the head shall be arranged to produce a relatively smooth cut with approximately 1/16 inch between peaks and valleys. Prior to beginning full production work involving asphalt pavement, the Contractor shall demonstrate to the Engineer the ability to achieve the desired surface without tearing or snagging the asphalt.

The cutting head shall be on its own suspension system, independent from that of the power unit, to allow the head to align itself with the slope of the pavement and/or any irregularities in the shoulder surface. The cutting tool shall be equipped with guides or a guidance system, clearly visible to the operator, to provide for consistent alignment of each SHARD.

- B. Installation and Dimensions.** The Contractor shall provide Work Zone Traffic Control as indicated in the contract documents.

SHARDs shall be installed within the limits indicated in the contract documents unless the limits are adjusted by the Engineer to meet existing field conditions. No milling shall be done within 4 inches of sawn and sealed transverse joints or longitudinal joints. SHARDs shall not be installed on bridge decks, concrete culvert surfaces, through crosswalks, through highway intersections, across commercial driveways, or as identified on the Plans or designated by the Engineer. SHARDs shall not be milled in over deteriorating pavement. Instead, the SHARDs should be placed 4 inches away from the deterioration, provided the remaining shoulder width is at least 3'-6" and the length of that reduced width does not exceed 100 feet for any given



deteriorated area. Where the line of SHARDs must be moved away from traffic, the transition should, to the extent practicable, be gently flared to maintain a smooth line.

As the work progresses, any portions of the shoulder or pavement that will accommodate traffic during the construction effort shall be cleaned by sweeping or flushing and the work area shall be reopened to traffic. At the end of each working day, the Contractor shall remove all equipment to a location where it does not present a hazard to traffic. The milled material shall be thoroughly removed from the shoulders. In areas with curbs or adjacent lawns or businesses, millings shall be removed from the project and disposed of in an acceptable manner. In uncurbed areas with no adjacent lawns or businesses, the millings may be swept off the shoulder to serve as shoulder back-up material.

**649-4 METHOD OF MEASUREMENT.** Audible Roadway Delineators will be measured as the sum of the lengths in linear feet of the individual segments where audible roadway delineators have been satisfactorily installed.

For milled-in audible roadway delineators, lengths will be measured along the inside edge of the shoulder from the center of the first milled-in audible roadway delineator in a segment to the center of the last milled-in audible roadway delineator in that segment. Where milled-in audible roadway delineators are provided on more than one shoulder, lengths will be measured separately for each segment and added to the sum. Individual gaps and exclusions under 100 feet in length will be included in segments identified for payment. Individual gaps and exclusions 100 feet or more in length will be excluded from segments identified for payment.

For centerline audible roadway delineators, lengths will be measured along the centerline of the CARDS from the center of the first centerline audible roadway delineator in a segment to the center of the last centerline audible roadway delineator in that segment. Individual gaps and exclusions under 100 feet in length will be included in segments identified for payment. Individual gaps and exclusions 100 feet or more in length will be excluded from segments identified for payment.

For secondary highway audible roadway delineators, lengths will be measured along the outside edge of the SHARDs from the center of the first SHARD to the center of the last SHARD. Individual gaps and exclusions under 300 feet in length will be included in segments identified for payment. Individual gaps and exclusions 300 feet or more in length will be excluded from segments identified for payment.

**649-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of all materials, equipment and labor necessary to satisfactorily complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
649.01	Milled-In Audible Roadway Delineators (MIARDs)	Linear Foot
649.11	Centerline Audible Roadway Delineators (CARDS)	Linear Foot
649.21	Secondary Highway Audible Roadway Delineators (SHARDs)	Linear Foot

## **SECTION 650 - TRENCHLESS INSTALLATION OF CASING**

**650-1 DESCRIPTION.** Under this work the Contractor shall furnish and install a casing by trenchless installation methods in accordance with the contract documents and as directed by the Engineer. The casing length, type, and size shall be as indicated in the contract documents. Acceptable methods of trenchless installation include Auger Boring, Slurry Boring, Pipe Jacking, Microtunneling, or Horizontal Directional Drilling. Pipe Ramming or Soil Compaction methods will not be allowed. For an installation under a railroad, methods which leave an uncased bore hole through the embankment will not be allowed.

**650-1.01 Definitions.** The following definitions were obtained from the NCHRP Synthesis 242 Trenchless Installation of Conduits Beneath Roadways.

**A. Auger Boring (AB).** A technique that forms a bore hole from a drive shaft to a reception shaft by means of a rotating cutting head. Spoil is transported back to the drive shaft by helical-wound auger flights rotating inside a steel casing that is being jacked in place simultaneously. AB may provide limited tracking and steering capability. It does not provide continuous support to the excavation face. AB is typically a 2-stage process (i.e., casing installation and product pipe installation).

**B. Slurry Boring (SB).** A technique that forms a bore hole from a drive shaft to a reception shaft by means of a drill bit and drill tubing (stem). A drilling fluid (i.e., bentonite slurry, water, or air pressure) is used to facilitate the drilling process by keeping the drill bit clean and aiding with spoil removal. It is a 2-stage process. Typically, an unsupported horizontal hole is produced in the first stage. The pipe is installed in the second stage.

**C. Pipe Jacking (PJ).** A technique for installing a prefabricated pipe through the ground from a drive shaft to a reception shaft. The pipe is propelled by jacks located in the drive shaft. The jacking force is transmitted through the pipe to the face of the PJ excavation. The excavation is accomplished, and the spoil is transported out of the jacking pipe and shaft manually or mechanically. Both the excavation and spoil removal processes require workers to be inside the pipe during the jacking operation.

**D. Microtunneling (MT).** A remotely controlled, guided pipe-jacking process that provides continuous support to the excavation face. The guidance system usually consists of a laser mounted in the drive shaft communicating a reference line to a target mounted inside the MT machine's articulated steering head. The MT process provides ability to control excavation face stability by applying mechanical or fluid pressure to counterbalance the earth and hydrostatic pressures.

**E. Horizontal Directional Drilling (HDD).** A 2-stage process that consists of drilling a small diameter pilot directional hole along a predetermined path and then developing the pilot hole into a suitable bore hole that will accommodate the desired utility and then pulling the utility into place. The HDD process provides the ability to track the location of the drill bit and steer it during the drilling process. The vertical profile of the bore hole is typically in the shape of an arc entrapping drilling fluid to form a slurry pathway rather than an open hole. This entrapped slurry provides continuous support to the bore hole.

**F. Utility Tunneling (UT).** A 2-stage process in which a temporary ground support system is constructed to permit the installation of a utility. The temporary tunnel liner is installed as the tunnel is constructed. Workers are required inside the tunnel to perform the excavation and/or spoil removal. The excavation can be accomplished manually or mechanically.

## **650-2 MATERIALS.**

### **650-2.01 Casing.**

**A. General.** Casing shall be of sufficient length and type and size as indicated on the contract documents.

**B. Pipe Jacking or Utility Tunneling Cutting Shield.** For a Pipe Jacking or Utility Tunneling operation, provide a steel cutting shield or poling plates designed to support the anticipated loading. The design shall allow for the attachment of temporary louvers in case collapsible soil conditions are encountered.

**1. Full Tunnel Shield.** The advancing face shall be provided with a hood extending not more than 20" beyond the face and extending around no less than the upper two-thirds of the circumference. It shall be of sufficient length to permit the installation of at least one complete ring of liner plates within the shield before it is advanced for the installation of the next ring of liner plates. It shall conform to and not exceed the outside dimensions of the pipe being installed by more than 1" at any point on the periphery, unless otherwise approved. It shall be adequately braced and provided with necessary appurtenances for completely bulkheading the face.

**2. Partial Tunnel Shield.** The advancing face shall be provided with a hood extending not more than 20" beyond the face and extending around no less than the upper one-third of the circumference. It shall conform to and not exceed the outside dimensions of the pipe being installed by more than 1" at any point on the periphery, unless otherwise approved.

**3. Poling Plates.** Poling plates shall be designed to support the ground outside the bounds of the tunnel through beam action. The beam action shall be capable of extending not more than 20" beyond the face and extending around no less than the upper one-third of the circumference. The poling plates shall conform to the configuration of the pipe being installed.

**C. Utility Tunneling Liner Plates.** For a Utility Tunneling operation, provide tunnel liner plates designed to support the anticipated loading. When a shield is used, the tunnel lining shall be designed to withstand the thrust from jacking the shield.

**1. Steel Tunnel Liner Plates.** Provide tunnel liner plates manufactured from steel meeting the metallurgic requirements of ASTM A569 with the following mechanical properties before cold forming:

- Minimum tensile strength: 42,000 psi.
- Minimum yield strength: 28,000 psi.
- Elongation, 2": 30%.

Tunnel liner plates shall be 2-flange with a minimum 0.209" thickness or 4-flange with a minimum 0.239" thickness. The nominal diameter shall be as indicated in the contract documents. Actual liner plate thickness shall be determined by the Contractor.

All tunnel liner plates shall be formed to provide circumferential flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both longitudinal and circumferential seams or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer's standard spacing and shall be a multiple of the plate length so the plates having the same curvatures will be interchangeable and will permit staggering of the longitudinal seams. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer's standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer's standard but not less than the required to meet the longitudinal seam strength requirements of AASHTO Standard Specifications for Highway Bridges, Section 15 Steel Tunnel Liner Plates.

All liner plates in the tunnel shall be the same type, and shall be interchangeable.

Liner plates shall be hot-dip galvanized in accordance with ASTM A123.

Bolts and nuts shall be not less than 5/8" in diameter. The bolts and nuts shall conform to ASTM A307 Grade A with rolled threads on bolts. Circumferential seam bolts shall conform to ASTM A307 or better.

Grout holes shall be 2" minimum diameter tapped couplings welded into place over holes cut in the liner plate. Provide a minimum of three grout holes, one every ring alternating 10, 12 and 2 o'clock position. Grout holes shall be provided with steel or iron threaded plugs.

**2. Precast Concrete Tunnel Liner Plates.** Precast concrete tunnel liner plates shall conform to the details shown in the contract documents and requirements of AASHTO Standard Specifications for Highway Bridges, Section 8 Concrete Structures. If such details are not provided, the Contractor may elect to propose the use of precast concrete liner plates.

**650-2.02 Filler Material.**

- A. Controlled Low Strength Material (CLSM).** Fill any abandoned borings with controlled low strength material (CLSM) (no fly ash) meeting the requirements of Section 204.
- B. Grout.** Fill any voids/ annular space between the casing and excavated boring with grout meeting the following requirements:

Material	Subsection
Portland Cement, Type 1 or 2	701-01
Grout Sand	703-04
Water	712-01
Bentonite (Optional) Bentonite Additives	There are no material requirements for bentonite, except that it shall be supplied in powdered form.

**650-2.03 Equipment.** Furnish equipment of adequate capacity and power to install the casing by trenchless installation methods. Supplement each rig with the necessary auxiliaries, appurtenances, tools, and other equipment required for proper operation. Tunnels may be excavated manually or by the use of tunnel boring machines (TBM's or "moles").

**A. Safety Equipment for Tunnel Entry.**

For safe personnel entry to the confined space,

- Provide a four gas meter atmospheric testing device, including oxygen, explosive gases, hydrogen sulfide and carbon monoxide. Testing equipment shall be calibrated as required by manufacturer and be in proper working condition.
- Provide mechanical ventilation (portable blower with flexible duct work) to purge the confined space and provide continuous ventilation.
- Provide body harness, life line, and mechanical retrieval equipment. If the confined space working environment has obstructions or turns such that mechanical retrieval equipment is not practical or creates more of a hazard, on-site rescue shall be immediately available prior to entry.

**650-3 CONSTRUCTION DETAILS**

**650-3.01 Approval.** Construction drawings, showing the proposed method and procedure of trenchless installation, construction of entrance and exit pits, and schedule of activities required to perform all trenchless installations indicated in the contract documents shall be submitted to the Engineer for approval before work on the trenchless installation operation is started. Approval of construction drawings shall not relieve the Contractor's responsibility to perform the work without damage to existing facilities. Field conditions may require changes in the approved drawings and such changes shall be subject to the approval of the Engineer. Approval will remain in force only as long as all conditions set forth in the approval are met and satisfactory results are obtained. In the event that unsatisfactory results and/or damage occurs, the Contractor shall stabilize the area and stop work, modify the methods of installation, and submit them for review and approval.

Clear all drill hole(s) and path locations in accordance with 16 NYCRR 753 *Protection of Underground Facilities*. For an installation under a railroad, additionally contact the railroad company to

identify the location of railroad underground facilities and the company's additional requirements pertaining to the method of installation.

Install casing of the length(s), size(s), and type(s) specified in the contract documents to the alignment(s) and profile(s) shown on the plans. For an installation under a railroad, work shall be carried out under the joint supervision of the Department and the railroad company, in accordance with §105-09 Work Affecting Railroads.

**A. Trenchless Installation Under Railroad.** Construction drawings, methods, work and necessary precautions related to trenchless installation under a railroad shall be submitted to, meet the requirements of, and have the approval of the Chief Engineer of the railroad company. No work shall commence until such approval has been received from the railroad company.

**B. Submittal.** Do not start work prior to receiving the Engineer's written approval. Approval will be based on the decision of the Deputy Chief Engineer for Technical Services (DCETS) as to the acceptability of the proposed work plan and any variations to provide satisfactory installation of the casing and avoid damage to the surrounding area and/or structure(s)/utilities. Installation of casing under railroads shall be jointly approved by the Department and the railroad company.

Information in this work plan shall include, but not be limited to, the following:

**1. General.**

- a. Qualifications of the Contractor showing that all trenchless installation operations will be performed by a competent driller who has successfully installed casing on two projects in the past five (5) years, of similar size and type shown on the plans, via the proposed trenchless method. Completed projects with details of the types of installations, owner contact names, and telephone numbers shall be included.
- b. Designed drill path indicating compliance with the contract documents. Unless otherwise indicated in the contract documents or directed by the Engineer, the minimum separation below the existing road surface and the top of casing shall be 5 feet. The minimum separation between the final ground surface and the top of pipe outside the pavement area shall be 3 feet.
- c. Equipment list including make and model number and specifications (catalog cuts) of all major equipment proposed for use. The Contractor is responsible for the final determination of the drill rig size based on the length and depth of the actual runs, the subsurface conditions expected, etc.
- d. Monitoring plan for the proposed path of the casing installation, including location of monitoring points and surveying intervals.
- e. Method for CLSM placement, including CLSM mix design, used for abandoning a boring.
- f. Method for grouting (e.g. grout hole locations, attachment of grout tube to outer circumference of casing, grid pattern for ground surface approach, etc.), including grout mix design, used for filling voids/ annular space between the casing and excavated boring.
- g. For instances where a utility is to be installed in the casing, method of installation and identification of the material to be placed between the casing and the utility carrier pipe. The material shall be nonconductive and retain its insulating properties during long-term submergence in water.

**2. Auger Boring.**

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure, thrust block design, tooling for drilling. Include details on the mechanical device that will prevent the cutting head from protruding ahead of casing and the need for a cutting shield at the head of casing.
- c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau (DGEB).
- d. Steering (e.g. articulated steering head) and tracking equipment (e.g. sonde transmitter & receiver, water level line, etc.), procedures, and proposed locations requiring surface or subsurface access.

### **3. *Slurry Boring.***

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure, tooling for drilling, water source for drilling operations, method to control slurry.
- c. If pit launched, design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.
- d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.
- e. Steering (e.g. articulated steering head) and tracking equipment (e.g. sonde transmitter & receiver, water level line, electromagnetic down-hole navigational system, etc.), procedures and proposed locations requiring surface or subsurface access.

### **4. *Pipe Jacking.***

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry for pipe lubrication, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure, thrust block design, tooling for drilling, verification that size and type of casing can withstand installation stresses and method to verify that installed casing is acceptable. Include details on the cutting shield at the head of casing and type of soil conveyance system to be utilized (e.g. wheeled carts, belt conveyor, slurry system, auger system, vacuum extraction system).
- c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate

Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

- d. Materials list including bentonite and bentonite additives proposed for pipe lubrication, along with material safety data sheets for all other materials used in the trenchless installation method.
- e. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.
- f. Outline of work in accordance with §107.05 Safety and Health Requirements, R. Confined Spaces and a written confined space plan (addresses prevention of unauthorized entry, type of hazard, work practices, monitoring, provision for attendant, duties of employees, rescue and emergency medical services, multi-employer operations, and provisions for review procedures).

#### **5. *Microtunneling.***

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry for pipe lubrication, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure, thrust block design, tooling for drilling, verification that size and type of casing can withstand installation stresses and method to verify that installed casing is acceptable. Include details on spoil removal system and controlling ground conditions via earth pressure balance at the face of the microtunneling boring machine (MTBM) (i.e. slurry or auger).
- c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.
- d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.
- e. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.

#### **6. *Horizontal Directional Drilling.***

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, location of slurry, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure, tooling for drilling, water source for drilling operations, method to control slurry.
- c. If pit launched, design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.

- d. Materials list including bentonite and bentonite additives proposed for use on the project, along with material safety data sheets for all other materials used in the trenchless installation method.
- e. Steering (e.g. offset jets incorporated into a direction sensing and steering head) and tracking equipment (e.g. sonde transmitter & receiver, electromagnetic down-hole navigational system, etc.), procedures and proposed locations requiring surface or subsurface access.

## 7. *Utility Tunneling.*

- a. Plan showing the work zone equipment configuration at the ends of the bore(s), staging areas, storage areas, cuttings and pit spoil-handling areas, and final placement areas.
- b. Boring procedure and tooling for tunneling. Include details on how to control the tunnel face (i.e. design calculations for a full tunnel shield or poling plates) and type of soil conveyance system to be utilized (e.g. wheeled carts, belt conveyor, auger system, vacuum extraction system).
- c. Design of entrance and exit pits including shoring elements, type, depth, bracing size, etc. All flexible wall-system designs that are part of the construction submittal shall be stamped by a licensed and currently registered New York State Professional Engineer and shall be done in accordance with the procedures contained in the appropriate Departmental publication, Geotechnical Design Procedure for Flexible Wall Systems (GDP-11). This publication is available upon request to the Regional Director or the DGEB.
- d. Steering and tracking equipment (e.g. laser & survey tools), procedures and proposed locations requiring surface or subsurface access.
- e. Outline of work in accordance with §107.05 Safety and Health Requirements, R. Confined Spaces and a written confined space plan (addresses prevention of unauthorized entry, type of hazard, work practices, monitoring, provision for attendant, duties of employees, rescue and emergency medical services, multi-employer operations, and provisions for review procedures).
- f. Engage the services of a professional engineer currently registered in the State of New York to provide the design of the Utility Tunnel.
  - i. Steel tunnel liner plate(s) shall be designed in accordance with AASHTO Standard Specifications for Highway Bridges, Section 15 Steel Tunnel Liner Plates. The design of the tunnel shall incorporate the combined effects of live and dead loads, hydrostatic loads, and loads, both temporary and permanent caused by the Contractor's methods of construction. The design shall meet the following minimum criteria:
    - Tunnel liner design shall meet the following minimum factors of safety:
    - Minimum Stiffness: 3.0.
    - Critical Buckling: 2.0.
    - Seam Strength: 3.0.
  - ii. Precast concrete tunnel liner plate(s) shall be designed in accordance with AASHTO Standard Specifications for Highway Bridges, Section 8 Concrete Structures. The design of the tunnel shall incorporate the combined effects of live and dead loads, hydrostatic loads, and loads, both temporary and permanent caused by the Contractor's methods of construction. Submit working drawings and design calculations including descriptions of materials to be used, plate dimensions, reinforcement details, connecting details, and erection procedures.



**650-3.02 Trenchless Installation Procedures.** Shore entrance and exit pits in accordance with the approved design.

Adequately protect any utilities located within the thrust block's zone of influence.

Survey the existing ground surface along the proposed path of casing installation prior to the start of work to set baseline data. Establish survey points in accordance with the approved design to determine presence/extent of ground movements.

**A. Installation.** Install the casing as follows:

1. The alignment of the casing shall conform to the following requirements:
  - Choose the ground entry and exit angles such that the casing can be installed along the alignment and profile indicated on the contract plans.
  - The entrance point(s) and exit point(s) shall be approved by the Engineer and physically located in the field by the Contractor.
  - The exit point shall be no more than  $\pm 1\%$  of the bore length left or right of the location marked in the field.
  - The vertical depth, as specified in the contract documents, is the depth to which the casing shall be installed.
2. Direct all drilling operations using steering and tracking systems capable of producing the required alignment within an allowable accuracy of  $\pm 1\%$  of the bore length. Maintain the grade within 2 inches throughout the bore length. The steering control system shall provide an angle of inclination reading and the direction in which the cutting tool is pointing. Provide access to the Engineer at all times to all measuring or gauging devices used for the drilling operations, including drilling logs maintained by the Contractor.
3. Closely monitor the trenchless installation process to eliminate ground movements. If ground movements occur, stop work and immediately stabilize the area of concern. If it is determined during the installation process that the proposed lines and grades for the casing cannot be achieved, stop work. The Contractor shall then modify the methods of installation and submit them for review and approval as stated in §650-3.01. Approval. Corrective stabilization actions are at the Contractor's expense.
4. In the event that the drill hole must be abandoned before completion of the installation or the installation is out of tolerance, fill the abandoned drill hole with CLSM to prevent subsidence. Start pumping from the farthest point of progression of the abandoned drill hole back to the surface to eliminate encapsulating voids. The progression and restoration of the abandoned drill hole by CLSM placement will be at the Contractor's expense. The location of the new drill hole shall be approved by the DCETS prior to progression of the operation as per §650-3.01. Approval.
5. For larger diameter casings, several passes with progressively larger cutting tools is allowable for producing the appropriate bore hole diameter.
6. For entry into casing by personnel:
  - Provide confined space training prior to entry, when there is a change in operations, or when deviation in policy occurs.
  - Entry Supervisor shall verify the requirements of the Entry Permit, ensure means of rescue are readily available, cancels or terminates entry as required, removes unauthorized personnel, and periodically monitors the Pipe Jacking operation for conformance.
  - Attendant shall maintain accurate account of authorized entrants, remains at entry site until relieved by another attendant or until work is complete, monitors conditions around space and maintains communication with entrant(s), and performs non-entry rescue or summons rescue and medical services, as needed.
  - Entrant(s) shall properly use required equipment, maintain communication with Attendant, and evacuate if emergency occurs.

- Confined spaces shall be monitored for oxygen, carbon monoxide, and explosive gases before and during entry. When organic material is present, hydrogen sulfide levels will be tested. Testing shall be conducted from top down as space allows at various levels. Test results shall be recorded on the permit. Entry shall not be made or the space shall be vacated when:
  - Oxygen levels are less than 19% or greater than 23%; or
  - Explosive gases are greater than 10% of lower explosion limit; or
  - Toxic gases greater than permissible exposure limits; or
  - Carbon Monoxide levels are greater than 35 ppm; or
  - Hydrogen Sulfide levels are greater than 10 ppm.
- Excavation shall not be advanced beyond the edge of the hood, except in rock, or with extreme care, to remove obstructions.
- 7. Grout voids/ annular space between the casing and excavated boring in accordance with the methods approved in the submittal process as stated in §650-3.01.Approval.
- 8. For instances where a utility is to be installed in the casing, place the utility carrier pipe within the casing such that they are electrically insulated from each other.

**B. Trenchless Installation Records.** After completion of the casing installation(s), submit to the Engineer the installation records detailing the As-Built location of the casing(s).

**C. Trenchless Installation Under Railroad.** Rail hangers shall be installed in accordance with the Temporary Track Support System item prior to the trenchless installation operation if required by the railroad company. In instances where unforeseen ground movements have occurred as a result of the trenchless installation operation, the rail hangers will not be removed by railroad forces until all ground movements of the embankment have been stabilized by the Contractor to the satisfaction of the railroad company.

**650-3.03 Subsidence.** The Contractor shall be held responsible for surface subsidence and damage or disturbance to adjacent property and facilities that may result from the construction methods. In case loose material is encountered and cave-ins occur or are anticipated, all trenchless installations shall be discontinued, approved shoring shall be provided and all voids filled either by pressure grouting or other approved methods before installations is continued.

Field conditions may require that the actual trenchless installation operations be continued without interruption in order to prevent undermining the roadway or the railroad roadbed and tracks. Should the Engineer permit interruption of trenchless installation operations in these instances, the Contractor shall provide bulkheads and dewatering measures as approved by the Engineer.

**650-3.04 Railroad Responsibility.** Any settlement or upheaval of the railroad tracks resulting from the casing installation and occurring within one year from the date the work is completed, will be corrected by the railroad company.

**650-4 METHOD OF MEASUREMENT.** The quantity to be paid for under this work will be the number of feet of casing, measured to the nearest foot, satisfactorily installed to the required length, grade, and alignment in accordance with the contract documents and as directed by the Engineer.

#### **650-5 BASIS OF PAYMENT**

**650-5.01 General.** The unit price bid per linear foot shall include the cost of furnishing all labor, materials, and equipment (including dewatering if required) necessary to satisfactorily complete the work.

Rail hangers (if required) shall be furnished, installed, and removed as called for in the Temporary Track Support System item included in the contract documents. This work will be paid for separately.

Costs incurred by the railroad company to correct settlement or upheaval of the railroad tracks resulting from the casing installation and occurring within one year from the date of work is completed, will be reimbursed to the railroad company directly by the State at no cost to the Contractor.

Surveying for the presence/extent of ground movements during the trenchless installation shall be paid for separately.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
650.10XX	Trenchless Installation of Casing Under Highway with a diameter less than or equal to 24”.	Foot
650.11XX	Trenchless Installation of Casing Under Highway with a diameter greater than 24” and less than or equal to 42”.	Foot
650.12XX	Trenchless Installation of Casing Under Highway with a diameter greater than 42”.	Foot
650.20XX	Trenchless Installation of Casing Under Railroad with a diameter less than or equal to 24”.	Foot
650.21XX	Trenchless Installation of Casing Under Railroad with diameter greater than 24” and less than or equal to 42”.	Foot
650.22XX	Trenchless Installation of Casing Under Railroad with a diameter greater than 42”.	Foot

**NOTE:** XX denotes casing diameter size.

**SECTION 651 - COMMUNICATION FACILITIES**

**651-1 DESCRIPTION.** The work in this section shall include special construction of communication facilities which are required for outside agencies such as police and fire departments.

The construction details for this work will be covered by special provisions in the contract documents.

**SECTION 652 - FURNISHING AND APPLYING SALTS**

**652-1 DESCRIPTION.** Under this work the Contractor shall furnish and apply salt for soil stabilization, as a dust palliative or for other purposes as specified.

**652-2 MATERIALS.** Materials for this work shall conform to the requirements of the following subsections of Section 700 - Materials and Manufacturing:

- Calcium Chloride 712-02
- Sodium Chloride 712-03

**652-3 CONSTRUCTION DETAILS**

**652-3.01 Stabilized Gravel Surface Course.** The Contractor shall apply salt for stabilization in accordance with the construction details specified in §411-3.

**652-3.02 Dust Control.** The Contractor shall apply salt on the highway to control dust at the locations and during periods as the Engineer may direct. The salt shall be applied on the dampened road surface by means of approved line spreader or equal equipment. An approved sprinkler or other approved method may be used to dampen the road surface. The recommended application rates for calcium chloride are as follows:

1 1/2 pounds per square yard per application  
4 1/10 pounds per square yard per year

**652-4 METHOD OF MEASUREMENT.** Salt shall be measured by the number of the tons furnished and applied.

**652-5 BASIS OF PAYMENT.** The unit price bid per ton shall include all labor, material and equipment necessary to complete the work including necessary water to dampen the road surface.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
652.01	Furnishing and Applying Calcium Chloride	Ton
652.02	Furnishing and Applying Sodium Chloride	Ton

## **SECTION 653 PAVEMENT RIDE QUALITY**

(New Section May, 2019)

**653-1 DESCRIPTION.** Collect and report pavement ride quality data from PCC (Portland Cement Concrete) and/or Asphalt.

**653-2 MATERIALS AND EQUIPMENT.** Use a Department certified inertial profiler and operator certified in accordance with Materials Method 653. Provide a copy of the certification letter to the Engineer before data collection.

### **653-3 CONSTRUCTION DETAILS.**

**653-3.01 Pavement Ride Quality (PRQ) Data Collection.** PRQ data consists of the longitudinal profile of the pavement.

Perform PRQ data collection when the pavement can be opened to construction traffic and/or after corrective actions, such as diamond grinding, have been completed. Perform three PRQ tests per lane in accordance with Materials Method 653.

Notify the Engineer before PRQ testing takes place. Submit ride quality results to The Engineer in accordance with Materials Method 653 within 45 days of completion of paving.

Submit results to the Engineer in accordance to Materials Method 653.

After the data is analyzed, calculate the corresponding quality units.

### **653-3.02 Corrective Action.**

Correct all 0.1-mile sections that fail to meet the requirements of Tables 653-1 and 653-2.

Perform PRQ testing again where corrective actions were performed to ensure that the International Roughness Index (IRI) values are below the values noted above. Perform additional corrective work until the IRI are below the above values.

**A. Diamond Grinding:** Diamond grind areas in accordance with Section 505 Diamond Grinding. All grinding must be performed for the full width of the driving lane.

- 1. Asphalt Pavement:** The total amount of grinding can not be more than 5% of the lane-miles. The surface texture after diamond grinding is acceptable and no additional texturing is required.
- 2. PCC Pavement:** If more than 20% of the reporting segment is ground for any reason, diamond grind 95%, minimum, of the entire reporting segment.

**B. Remove and Replace:**

1. **Asphalt Pavement:** Perform corrective work by removing and replacing to the depth necessary to correct the deviations.
2. **PCC Pavement:** Perform corrective work by removing and replacing full depth sections as necessary.

**653-4 METHOD OF MEASUREMENT.**

The quantity to be measured for payment will be in quality units.

**Quality Unit Calculation.** PRQ pay adjustments will be based on Total Quality Units (TQU). Total Quality Units is the summation of the IRI Quality Units (IRIQU) and the Localized Roughness Quality Units (LRQU):

$$TQU = (IRIQU) + (LRQU)$$

**A. International Roughness Index Quality Units (IRIQU)**

- Determine Quality Units for each PRQ lot using Table 653-01 for Asphalt Pavements and Table 653-02 for PCC Pavements and Materials Method 653.
- For PRQ lots of a length different from 528 ft, adjust the number of Quality Units as follows:

$$IRIQU = \text{Quality Units from appropriate table} \times (\text{Length of PRQ lot (ft)} / 528(\text{ft}))$$

- Determine the total number of IRI Quality Units for the project by summing the Quality Units from all PRQ lots.

<b>Table 653-01</b>			
<b>Determination of IRI Quality Units (IRIQU) for Asphalt Pavements</b>			
<b>Level 1</b>		<b>Level 2</b>	
<b>PRQ lot IRI (in/mile)</b>	<b>Quality Units</b>	<b>PRQ lot IRI (in/mile)</b>	<b>Quality Units</b>
≤45	8	≤50	4
46-59	(60-IRI)*0.5	51-64	(65-IRI)*0.25
60-74	0	65-79	0
75-90	(74-IRI)	80-95	(79-IRI)*0.5
>90	Corrective action	>95	Corrective action

<b>Table 653-02</b>			
<b>Determination of IRI Quality Units (IRIQU) for PCC Pavements</b>			
<b>Level 1</b>		<b>Level 2</b>	
<b>PRQ lot IRI (in/mile)</b>	<b>Quality Units</b>	<b>PRQ lot IRI (in/mile)</b>	<b>Quality Units</b>
≤50	8	≤57	4
51-64	(65-IRI)*0.5	58-64	(65-IRI)*0.5
65-79	0	65-79	0
80-95	(79-IRI)	80-95	(79-IRI)*0.5

>95	Corrective action	>95	Corrective action
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**B. Localized Roughness Measurement (LRQU)**

- Determine the localized roughness lane lot percentage based on *Materials Method 653 Localized Roughness Summary Report*. Calculate the Localized Roughness Quality Units (LRQU) based on the following equation:

$$LRQU = \text{lane percentage} * \text{total quality units in contract} * (-2)$$

**653-5 BASIS OF PAYMENT.**

Include the cost of all labor and equipment necessary to satisfactorily complete the work. Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed price for Quality Adjustment Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

*Payment will be made under:*

Item No.	Item	Pay Unit
653.1010	Pavement Ride Quality Adjustment to Asphalt Level 1	Quality Unit
653.1020	Pavement Ride Quality Adjustment to Asphalt Level 2	Quality Unit
653.2010	Pavement Ride Quality Adjustment to PCC Level 1	Quality Unit
653.2020	Pavement Ride Quality Adjustment to PCC Level 2	Quality Unit

**SECTION 654 - IMPACT ATTENUATORS - PERMANENT**

(Last Revised May, 2019)

**654-1 DESCRIPTION.**

**654-1.01 General.** The work shall consist of furnishing and installing; removing and disposing; removing and storing; and relocating; impact attenuators, and installing foundations for impact attenuators, in accordance with the contract documents, the working drawings, and as directed by the Engineer.

**654-1.02 Inertial Barrier Modules.** An impact attenuator consisting of sand-filled modules (barrels) set in an array for site hazard protection.

**654-1.03 Expendable Impact Attenuator.** Impact attenuator which requires extensive repair, or replacement, to return the unit to its full operating capacity.

**654-1.04 Concrete Foundation for Impact Attenuator.** A new concrete foundation on which an attenuator is placed or, if required, anchored.

**654-1.05 Transition Piece(s).** Components of the attenuator system that are designed to connect between the attenuator and the shielded object in such a manner as to prevent an impacting vehicle from snagging on the shielded object. Not all installations require a transition piece and some transition pieces must be capable of handling opposite direction impacts.

**654-2 MATERIALS.** Materials shall conform to the following subsections of Section 700 *Materials and Manufacturing*:

Class A Concrete 501-2

Concrete Grouting Material	701-05
Anchoring Material- Chemically Curing	701-07
Precast Concrete	704-03
Epoxy Coated Bar Reinforcement, Grade 420	709-04
Expendable Impact Attenuator	712-06
Inertial Barrier Modules	712-07
Galvanized Coating and Repair Methods	719-01
Anchor Bolts, Nuts and Washers	723-60
Traffic Paint (White)	727-09
Aluminum Sign Panels	730-01
Reflective Sheeting	730-05

### 654-3 CONSTRUCTION DETAILS.

#### 654-3.01 General.

**A. Drawings.** Manufacturer’s drawings, modified as necessary to reflect site conditions, will be referred to as “working drawings.” Working drawings will take precedence over manufacturer’s drawings. Working drawings shall show attenuator system: supports, transition pieces, connections, miscellaneous parts, concrete or steel back-up structure, and anchorages not detailed in the plans, but which are necessary to develop the full performance of the impact attenuator. Attenuator mounting surface or foundation slab details and limits, will be shown in the working drawings. Any component not supplied by the manufacturer will be labeled as “PROVIDED BY OTHERS”. A minimum of 7 calendar days prior to beginning work, the Contractor shall submit three (3) copies of working drawings to the Engineer. The submission shall include the manufacturer’s certification that modifications made to manufacturer’s drawings reflecting site conditions will not impair the satisfactory performance of the impact attenuator as designed and tested under NCHRP requirements. All aspects of the working drawings shall be implemented in the field, including any alterations of the concrete barrier or other obstruction being shielded.

**B. Manuals.** A minimum of 7 calendar days prior to beginning work, the Contractor shall deliver to the Engineer 3 copies of design manuals, installation manuals, parts lists, and maintenance manuals prepared for each type of impact attenuator being installed.

**C. Coordination with Other Work.** Coordinate the work under this section with removal and installation of shielded objects, barriers and guide rail in such manner as to limit the exposure of vehicular traffic to potential hazards to no more than 7 calendar days.

**D. Excavation.** Necessary excavation shall be performed in accordance with Section 203 *Excavation and Embankment*. Where the perimeter of the foundation slab will not be adjacent to pavement, the limit of excavation shall be 2 feet outside of the slab and forming shall be used. Where the perimeter of the foundation slab will be adjacent to pavement that is to remain in place, the limits of excavation shall be the limits of the foundation slab and the existing pavement shall be saw cut full depth prior to removal of the pavement and performance of the excavation work. Sawcutting and excavation shall be included in the cost of the foundation.

**E. Anchorages.** The impact attenuator shall be anchored to the new foundation slab or existing concrete foundation as shown on the working drawings. Anchor bolts and studs not cast integrally into the new foundation slab shall be anchored with approved concrete expansion anchors, concrete grouting material, or approved chemically curing anchoring material. Such anchor bolts or studs shall be set into holes drilled with rotary impact drills of the size recommended by the manufacturer of the

anchor. Core drills will not be acceptable. Care shall be taken that anchor studs projecting from the surface and exposed to foot or wheeled traffic be well marked or protected.

A backup structure, if required by the manufacturer, shall be installed as indicated in the approved Materials Details or working drawings.

**F. Transitions.** The Contractor shall install the appropriate standard transition piece(s). If a transition is needed, but there is no standard transition design, a manufacturer's approved special transition piece, subject to the Engineer's approval, shall be furnished and installed. Refer to §654-3.01A for submittal requirements.

**G. Directionality.** When the contract documents indicate that an attenuator must handle two-way traffic, rather than diverging traffic, the Contractor shall supply an attenuator that is approved for the two-way traffic.

**H. Reflectorization.** ASTM Type III (Class B), Type V (Class C), or Type IX (Class E) sheeting directly applied to plastic or aluminum sheeting, or other lightweight rigid material, shall be affixed to the front cylinder, module, or front face of the impact attenuator. The pattern and color of the reflectorization shall be as indicated in the contract documents.

If no dimensions are provided, the panel shall be approximately square with a minimum of 18 inches on a side (24 inches on Inertial Barrier Modules). Whenever approaching traffic is allowed to pass on both sides of the unit, the pattern shall be upward pointing v-shaped striping, 4 inches wide, alternating between reflectorized yellow and opaque non-reflectorized black stripes, as indicated for Type 3 Object Markers in the MUTCD.

When traffic will be permitted on only one side, the pattern shall be diagonal 4 inch stripes, downward sloping to the side on which traffic is to be permitted.

**654-3.02 Inertial Barrier Modules.** The Contractor shall install Inertial Barrier Modules of the size and number required at the locations, and to the configurations, indicated in the contract documents. The Contractor shall also paint and label the layout pattern and weights on paved surfaces using traffic or other durable paint. The weight shall be marked. When either indicated in the contract documents or when the modules are placed on a bridge deck on any slope exceeding 6%, the 200 lb units shall be restrained from movement and overturning (vandalism) by mechanical means.

**654-3.03 Expendable Impact Attenuators.** The Contractor shall install Expendable Impact Attenuators on existing or new foundations, as indicated on the contract documents and the working drawings.

**654-3.04 Concrete Foundation.** When the existing concrete pavement is not sufficient to meet the anchorage requirements or there is not an adequate existing foundation, the Contractor shall remove the existing pavement and construct a reinforced concrete foundation slab and back-up structure to the dimensions indicated in the working drawings. The foundation slab shall be not less than the thickness indicated on the working drawings, or 8 inches, whichever is greatest.

The concrete shall be batched in accordance with Section 501 *Portland Cement Concrete*. If accelerators are needed, the Contractor shall submit the concrete mix design to the Materials Bureau for prior approval. The concrete shall be formed (when necessary), placed, and cured in accordance with Section 502 *Portland Cement Concrete Pavement*. The surface shall be hand finished.

The size, length, and bending details of reinforcement shall be as shown in the foundation slab details in the working drawings. The minimum allowable reinforcing shall be epoxy-coated #5 bars, with longitudinal spacing 16 inches on centers, and cross bar spacing 6 feet on centers. Longitudinal bars shall be placed such that they will not be cut during anchorage installation.



If foundation slab removal is specified, voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as specified in the contract documents or by the Engineer.

The excavated section of pavement between the new foundation slab and the limits of excavation shall be restored to the full height of the surrounding sound pavement.

**654-3.05 Removal and Disposal.** The Contractor shall remove impact attenuators of the indicated type, and if required the associated foundation slabs, from their existing locations. Upon removal, the impact attenuators and foundation slabs shall become the property of the Contractor. If foundation slab removal is specified, voids resulting from the removal of foundation slabs shall be filled with compacted suitable material or compacted granular material, or other designated material as specified in the contract documents or by the Engineer.

If the slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

**654-3.06 Removal and Storage.** The Contractor shall remove impact attenuators of the indicated type from their existing locations in a manner that preserves their condition. The impact attenuators shall remain the property of the State, and the Contractor shall store and protect them in a manner that preserves their condition at locations within the contract limits. Parts damaged by the Contractor's activities shall be replaced with like parts in satisfactory condition or repaired at no cost to the State.

If the slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

**654-3.07 Relocate.** The Contractor shall remove impact attenuators of the indicated type from their existing locations in a manner that preserves their condition, and reinstall them at the same location or install them at another designated location. The impact attenuators shall remain the property of the State during the course of the work.

If required, the Contractor shall construct a new foundation slab. The cost of the new foundations will be paid for separately. If intermediate storage is required during the relocation, the Contractor shall store and protect impact attenuators. Damaged parts shall be replaced with like parts in satisfactory condition or be repaired at no cost to the State. The cost of replacing or repairing parts having pre-existing damage will be considered Extra Work.

If the original slab is to remain in place, holes in and other damage to the surfaces underlying the impact attenuator shall be repaired. Anchor bolts or studs that are no longer required or usable shall be removed or cut off flush with the surface.

#### **654-4 METHOD OF MEASUREMENT.**

##### **654-4.01 General. (VACANT)**

**654-4.02 Inertial Barrier Modules.** The quantity to be measured for payment will be the number of inertial barrier modules installed.

**654-4.03 Expendable Impact Attenuator.** The quantity to be measured for payment will be the number of expendable impact attenuators installed.

**654-4.04 Concrete Foundation for Impact Attenuator.** The quantity to be measured for payment will be in cubic yards of reinforced concrete foundation installed.

**654-4.05 Remove and Dispose.** The quantity to be measured for payment will be the number of impact attenuators removed.

**654-4.06 Remove and Store.** The quantity to be measured for payment will be the number of impact attenuators removed.

**654-4.07 Relocate.** The quantity to be measured for payment will be the number of impact attenuators relocated.

**654-5 BASIS OF PAYMENT.**

**654-5.01 General.** The unit prices bid for the work described in this section shall include the cost of all labor, materials, and equipment necessary to satisfactorily perform the work.

Pavement restoration: Pavement restoration will be paid for separately under the contract pay items for Truing and Leveling. If there are no contract pay items for Truing and Leveling, then pavement restoration will be paid under the contract pay item for the top course of hot mix asphalt. If no contract pay items exist in the contract for paving items, then no separate payment for pavement restoration will be made.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
654.01xx	Inertial Barrier Module, ___ Pounds xx =01 for 200 lb units; 02 for 400 lb units; 03 for 700 lb units; 04 for 1400 lb units; 05 for 2100 lb units.	Each
654.05	Concrete Foundation for Impact Attenuators	Cubic Yards
654.06	Drill and Grout Anchoring System into Existing Foundation	Each
654.0701	Remove and Dispose Impact Attenuator Systems	Each
654.0702	Remove and Store Impact Attenuator	Each
654.08	Relocate Impact Attenuator	Each
654.5020	Expendable Impact Attenuator , TL 2, ≤ 2 ft Obstruction Width	Each
654.5022	Expendable Impact Attenuator , TL 2, > 2 ft up to 5 ft Obstruction Width	Each
654.5025	Expendable Impact Attenuator , TL 2, > 5 ft Obstruction Width	Each
654.5030	Expendable Impact Attenuator , TL 3, ≤ 2 ft Obstruction Width	Each
654.5032	Expendable Impact Attenuator , TL 3, > 2 ft up to 5 ft Obstruction Width	Each
654.5035	Expendable Impact Attenuator , TL 3, > 5 ft Obstruction Width	Each

**SECTION 655 - FRAMES, GRATES AND COVERS**

(Last Revised September, 2019)

**655-1 DESCRIPTION.** This work shall consist of furnishing and placing frames, grates, covers and curb boxes for drainage structures as shown on the plans or as directed by the Engineer.

**655-2 MATERIALS**

**655-2.01 Castings.** All castings manufactured in conformance to the Standard Sheet “Telescoping Manhole Casting & Ring” shall meet the requirements of §715-05 Iron Castings, Class No. 30B or Class No. 35B. All other castings (gratings, covers, frames and curb boxes) shall meet the requirements of §715-02, Steel Castings, Grade N-1; or §715-07, Proof-Loaded Iron Castings; or §715-09, Malleable Iron Castings, Grade 32510, at the Contractor's option. No substitutions will be allowed.

**655-2.02 Fabricated Articles.** All frames, grates and appurtenant parts shall be fabricated from steel conforming to ASTM A36, AISI Grade 1020 Steel, AISI Grade 1025 Steel, or ASTM A529 Gr. 50, except that the longitudinal bars for grates G1, G2, G3, 10 PCB, 11 PCB and 12 PCB shall meet the requirements of ASTM A529, Gr. 50. The Contractor shall submit mill certifications, to the Engineer, for ASTM A529, Gr.50. Welding or splicing by welding of any member of the frame or grate, other than the welds shown on the standard sheets, plans, approved shop drawings, approved Materials Details, or in the proposal will not be permitted. Galvanizing shall be in accordance with §719-01 Type I, unless indicated otherwise.

Welding shall comply with the requirements specified in the New York State Steel Construction Manual, except that radiographic inspection will not be required.

**655-3 CONSTRUCTION DETAILS**

**655-3.01 Frames and Grates.** Frames, covers and grates shall be placed true to line and grade. Covers, grates and frames shall make firm, full and even bearing on their respective underlying surfaces and shall be non-rocking under the influence of traffic or other loads. On all frames, the Contractor shall have the option of drilling and tapping holes or drilling holes in and welding nuts to the bottom of the frame to facilitate the stud bolts used to hold down the grate. Alternate forms of locking will be approved by the office of Design.

Unless otherwise specified, the hole shall be drilled and tapped or the nut welded to the frame before any galvanizing. The threads shall be tapped sufficiently oversize to conform to the dimensions for coarse thread with class 2B tolerances prescribed in the American National Standards for Unified Screw Threads, ANSI Bi.1., after galvanizing.

**655-3.02 Field Repairs for Improperly Fitting Systems.** The Contractor may propose to the Engineer reasonable field repair procedures for improperly fitting castings. No field repairs of improperly fitting fabricated frames and grates shall be allowed. Field repairs may include grinding and/or proper welding techniques for the materials involved. Repairs that involve welding shall be allowed only on steel castings, and not on iron, and only with prior approval of the DCES. Implemented repairs must result in systems whose constituent parts have full, uniform and even bearing contact on their respective underlying surfaces and that do not rock or move under the influence of traffic and other loads. All such repairs must be completely satisfactory to the Engineer or the work will be rejected. All repairs shall be done at no cost to the State.

**655-4 METHOD OF MEASUREMENT**

**655-4.01 Frames and Grates.** The quantity to be measured for payment will be the number of frames and grates satisfactorily installed.

**655-5 BASIS OF PAYMENT**

**655-5.01 Frames and Grates.** The unit price bid for each frame and grate shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including the cost of any field repair work for improperly fitting castings or to render the frame and grate non-rocking.

*Payment will be made under:*

<b>Item No.</b>	<b>Item Description</b>	<b>Pay Unit</b>
655.0701	Cast Frame F1, Mountable Curb Box CM1 & Reticuline Grate G1	Each
655.0702	Cast Frame F2, Mountable Curb Box CM2 & Reticuline Grate G2	Each
655.0703	Cast Frame F3, Mountable Curb Box CM3 & Reticuline Grate G3	Each
655.0704	Cast Frame F1, UnMountable Curb Box CU1 & Reticuline Grate G1	Each

655.0705	Cast Frame F2, UnMountable Curb Box CU2 & Reticuline Grate G2	Each
655.0706	Cast Frame F3, UnMountable Curb Box CU3 & Reticuline Grate G3	Each
655.0801	Cast Frame F1, Mountable Curb Box CM1 & Parallel Bar Grate 6 PCB	Each
655.0802	Cast Frame F2, Mountable Curb Box CM2 & Parallel Bar Grate 7 PCB	Each
655.0803	Cast Frame F3, Mountable Curb Box CM3 & Parallel Bar Grate 8 PCB	Each
655.0804	Cast Frame F1, UnMountable Curb Box CU1 & Parallel Bar Grate 6 PCB	Each
655.0805	Cast Frame F2, UnMountable Curb Box CU2 & Parallel Bar Grate 7 PCB	Each
655.0806	Cast Frame F3, UnMountable Curb Box CU3 & Parallel Bar Grate 8 PCB	Each
655.0901	Parallel Bar Frame 10 PCB & Parallel Bar Grate 10 PCB	Each
655.0902	Parallel Bar Frame 11 PCB & Parallel Bar Grate 11 PCB	Each
655.0903	Parallel Bar Frame 12 PCB & Parallel Bar Grate 12 PCB	Each
655.1003	Welded Frame & Rectangular Grate 3	Each
655.1006	Welded Frame & Rectangular Grate 6	Each
655.1011	Welded Frame & Rectangular Grate 11	Each
655.1016	Welded Frame & Rectangular Grate 16	Each
655.1022	Welded Frame & Rectangular Grate 22	Each
655.1103	Welded Frame & Reticuline Grate 3	Each
655.1106	Welded Frame & Reticuline Grate 6	Each
655.1111	Welded Frame & Reticuline Grate 11	Each
655.1116	Welded Frame & Reticuline Grate 16	Each
655.1122	Welded Frame & Reticuline Grate 22	Each
655.1201	Manhole Frame & Grate	Each
655.1202	Manhole Frame & Cover	Each
655.1301	Telescoping Manhole Frame & Grate	Each
655.1302	Telescoping Manhole Frame & Cover	Each

## SECTION 656 - MISCELLANEOUS METALS

**656-1 DESCRIPTION.** This work shall consist of furnishing and placing all metal component parts in accordance with the specifications which are not included in other items of work and which are specifically identified on the plans to be reimbursed at the unit bid price for Miscellaneous Metals.

**656-2 MATERIALS.** Metals required for this work shall meet the requirements of the following Subsections of Section 700 - Materials and Manufacturing:

Castings, Forgings, and Metals (As Specified)	715
Miscellaneous Metals and Plastics (As Specified)	725

### 656-3 CONSTRUCTION DETAILS

**656-3.01 Drawings.** Shop drawings shall be prepared, approved and distributed in accordance with the provisions of the SCM. When applicable, the manufacturer's specification data sheet (catalog clip) may be furnished in lieu of shop drawings. The Engineer may waive the shop drawing requirement for any non-welded component part that can be fabricated directly from the details shown on the plans.

**656-3.02 Welding.** Welding shall comply with the requirements specified in the *New York State Steel Construction Manual*.

**656-3.03 Galvanizing.** When materials for this work are to be galvanized, the process and spelter coating shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods.

**656-3.04 Painting.** All unembedded metal except castings shall be painted in accordance with Section 574, Localized Painting of Structural Steel. Galvanized material shall be painted in accordance with Section 657.

**656-4 METHOD OF MEASUREMENT.** Payment for this work shall be measured by the number of pounds of metal furnished and placed in accordance with the plans and specifications.

**656-5 BASIS OF PAYMENT.** The unit price bid per pound shall include all labor, materials and equipment necessary to complete the work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
656.01	Miscellaneous Metals	Pound

## **SECTION 657 – PAINTING GALVANIZED AND ALUMINUM SURFACES**

(Last Revised May, 2018)

**657-1 DESCRIPTION.** This work shall consist of painting galvanized and aluminum surfaces that have not been previously painted.

### **657-2 MATERIALS**

**657-2.01 Paint for Use on Galvanized Surfaces.** Material for this work shall meet the requirements of §708-06 *Paint for Galvanized Surfaces*.

**657-2.02 Paint for Use on Aluminum Surfaces.** Material for this work shall meet the requirements of §708-07 *Paint for Aluminum Surfaces*.

#### **657-2.03 Paints.**

**A. Product Data.** At least five work days prior to the start of work, the Contractor shall supply the Engineer with one copy of the paint manufacturer’s current product data and safety data sheet for each coat to be applied. If manufacturer’s recommendations are more restrictive or require additional effort not defined in this specification, then the manufacturer’s recommendations shall be followed.

**B. Storage.** Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

**C. Color.** The color of the primer will be the Contractor’s option; however, it shall contrast with the underlying substrate. The color of the topcoat shall be in accordance with the contract documents or defined by §708-05. A ‘Rustic’ color shall be Weathered Brown.

**D. Shelf Life.** Any container of paint more than 12 months old based on the date of manufacture shall not be used. Paint arriving at the work site shall be in new, unopened containers and labeled with the manufacturer’s name, product name, component part, batch number, color, and date of manufacture.

**657-2.04 Water for Pressure Washing.** Potable water shall be used.

**657-2.05 Abrasive for Brush-Off Blasting Galvanizing Surfaces.** Abrasive size shall range between 8 and 20 mils, and shall have a Mohs hardness of 5 or less. Steel grit, steel shot, or copper slag shall not be used.

**657-2.06 Paint Inspection Equipment.** The Contractor shall ensure that the Engineer is supplied and maintained with the following equipment in good working order, prior to the start of work:

- One bound copy of the Steel Structures Painting Council Surface Preparation Standard SSPC-SP 1 “Solvent Cleaning”.
- One bound copy of the Steel Structures Painting Council Surface Preparation Specification SSPC-SP 16 “Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals”.
- One bound copy of the Steel Structures Painting Council SSPC-PA 2, Paint Application-Standard No. 2 “Procedure for Determining Conformance to Dry Coating Thickness Requirements”.
- ASTM A123 Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
- ASTM D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
- ASTM D4285 Standard Test Method for Indicating Oil or Water in Compressed Air.
- One Air Thermometer, pocket type, 10°F to 110°F.
- One Magnetic Dry-Film Thickness Gauge, Type 2 (fixed probe).
- Two Wet-Film Thickness Gauges, Prong-Type, capable of measuring 1 mil to 10 mils in 1 mil increments.
- Sling Psychrometer and US Weather Bureau Psychrometric Tables.
- Profile micrometer with coarse replica tape.

All equipment will be returned to the Contractor upon completion of the work.

### **657-3 CONSTRUCTION DETAILS**

**657-3.01 Classification and Surface Preparation of Surfaces.** A surface will be considered weathered if the galvanizing has been uncoated and exposed to a well-ventilated environment for a minimum of two years. A surface will be considered new if it was galvanized less than two years ago.

**A. Weathered Galvanized Surfaces.** All surfaces to be painted shall be pressure washed using equipment operating at a minimum pressure of 1450 psi, a water temperature of 185°F to 200°F, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches from the surface.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil and grease, animal waste, salts, and other debris. Oil and grease shall be removed by solvent cleaning as described in SSPC-SP 1. The areas shall be pressure washed again following this cleaning.

**B. Newly Galvanized Surfaces.** All surfaces to be painted shall be pressure washed using equipment operating at a minimum pressure of 3000 psi, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches from the surface.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil and grease, animal waste, salts, and other debris. Oil and grease shall be removed by solvent cleaning as described in SSPC-SP 1. The areas shall be pressure washed again following this cleaning.

Once cleaned and allowed to dry, all galvanized surfaces shall receive an abrasive brush-off blast per SSPC-SP 16, using clean compressed air. The Contractor shall verify the compressed air cleanliness with a white blotter test in accordance with ASTM D4285 at least once per shift.

The brush-off blast shall remove zinc oxides from the galvanizing as well as etch the surface to impart an anchor profile of 1 to 1 ½ mils. The resultant anchor profile shall be confirmed by measuring using profile tape and a spring-loaded micrometer in accordance with ASTM D4417.

The brush-off blast shall be performed in a manner that does not result in debonding or flaking of the galvanizing. The brush-off blast shall not remove excessive amounts of zinc from the galvanized surface. The initial thickness of the galvanizing prior to brush-off blasting shall be established using a magnetic thickness gauge in accordance with ASTM A123. If the brush-off blast results in a 15% or greater loss of galvanized coating, the article shall be rejected. If an article is rejected, the Contractor shall strip, re-galvanize and brush-off blast it to conform to the requirements of this specification at no additional cost to the State.

After brush-off blasting, the galvanized surfaces shall be thoroughly blown down with clean compressed air to remove all blast residue. Any sharp, protruding defects in the galvanized surface such as that commonly found on edges and holes shall be removed using hand tools.

Brush-off blasting shall be completed no more than 1 hour prior to paint application. If more than 1 hour elapses prior to priming, the galvanized surfaces shall be re-blasted at no additional cost to the State. If re-blasted, the item shall not have lost 15% or more of its original galvanized coating thickness.

**C. Aluminum Surfaces.** All surfaces to be painted shall be pressure washed using equipment operating at a minimum pressure of 3000 psi, and a minimum flow of 4 gallons/minute. The nozzle shall be held at a distance of 6 inches to 12 inches from the surface.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil and grease, animal waste, salts, and other debris. Oil and grease shall be removed by solvent cleaning in accordance with SSPC-SP 1. The areas shall be pressure washed again following this cleaning.

Once cleaned and allowed to dry, all aluminum surfaces shall receive an abrasive brush-off blast in accordance with SSPC-SP 16. All compressed air used to satisfy the requirements of this specification shall be clean. The cleanliness shall be verified with a white blotter test in accordance with ASTM D4285 at least once per shift.

The brush-off blast shall remove aluminum oxides as well as etch the surface. The brush-off blast shall impart a minimum anchor profile of 1 mil as measured using profile tape and a spring-loaded micrometer in accordance with ASTM D4417.

After brush-off blasting, the aluminum surfaces shall be thoroughly blown down with clean compressed air to remove all blast residue.

Brush-off blasting shall be completed no more than 1 hour prior to paint application. If more than 1 hour elapses prior to priming, the aluminum surfaces shall be re-blasted at no additional cost to the State.

### **657-3.02 Painting.**

**A. Atmospheric Conditions.** Paint shall be applied only when surface and ambient temperatures are greater than or equal to 40°F and rising, and less than or equal to 100°F. If the temperature range listed on the manufacturer's product data sheet is more restrictive, the manufacturer's temperature range shall be used. No paint shall be applied unless the receiving surface is absolutely dry.

Paint shall not be applied when the relative humidity is more than 85% or the surface temperature is less than 5°F above the dew point. If the manufacturer's requirements are more restrictive than they shall be followed.

Paint shall not be applied if ambient conditions are expected to become unfavorable prior to the paint drying “To Handle”, in accordance with the manufacturer’s product data sheet.

**B. Mixing Paint.** Paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer’s recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use. The paint shall be periodically re-mixed if recommended by the manufacturer.

**C. Solvents and Thinners.** Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The paint shall not be thinned where the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205 for industrial maintenance coatings. The manufacturer shall advise the Contractor and Engineer as to the maximum amount of thinner allowed.

The Contractor shall not use unauthorized solvents and thinners, or excess amounts of solvents and thinners. Paint thinned excessively or incorrectly shall be removed at no additional cost to the State. The use of accelerator additives is prohibited.

**D. Paint Application.** The Contractor shall not begin painting until cleaned surfaces have been inspected. The Contractor shall also provide sufficient time for the work to be inspected at each stage of paint application. The item(s) shall cure in an environment that is free of airborne dust and dirt until the paint is dry to handle. Paint may be applied using brush or roller, unless otherwise indicated by the contract documents. All paint shall be applied to produce a uniform, even coating free of runs, sags, drips, ridges or other defects. Areas exhibiting these defects shall be re-cleaned at no additional cost to the State.

Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating and not leave fibers in the coating. The roller nap length shall be limited in accordance with the paint manufacturer’s recommendation.

If the surface becomes contaminated before paint is applied, or if more than 1 hour elapses after brush-off blasting prior to priming, the surface preparation shall be redone at no additional cost to the State.

**E. Paint Film Thickness.** The Contractor shall apply paint to produce the specified dry film thickness in accordance with the paint manufacturer’s product data sheet.

The dry film thickness over galvanized steel shall be determined in accordance with SSPC-PA 2 using a Type 2 fixed-probe magnetic gauge. The gauge shall be properly calibrated over the galvanized steel surface in accordance with the manufacturer’s recommendation prior to paint application.

The dry film thickness over aluminum surfaces will be estimated using a wet film thickness gauge.

Areas failing to meet the specified minimum dry film thickness shall be overcoated with the same type of paint to produce the required dry film thickness. The overcoating shall be performed within the paint manufacturer’s specified recoat window.

**657-3.03 Repair of Damaged Areas.** The Contractor shall remove all visible dirt, grease, and other foreign matter by pressure washing and solvent cleaning in accordance with SSPC-SP 1 as needed. Areas exhibiting damaged or deteriorated paint not extending to the aluminum or zinc metal substrate shall be hand or power tool cleaned as necessary to remove damaged or deteriorated, loosely adhered paint, until the paint does not lift when scraped with a dull putty knife. All edges of paint surrounding the repair area shall be tightly adherent and feathered. These edges and the surrounding painted surfaces to receive a repair topcoat(s) shall be abraded to provide a suitable anchor profile for the paint.

Areas that exhibit damage of the paint system down to the metal substrate shall be cleaned with vacuum-shrouded tools to SSPC-SP 16, minimizing zinc galvanizing removal, and shall exhibit a suitable



anchor profile for the primer paint. All surrounding structure that has been previously painted in the shop shall be protected from damage during the cleaning operation. Repairs shall be smoothly transitioned into surrounding new paint.

Areas of the structure exhibiting damage not extending down to the metal substrate shall be repainted with a finish coat only. Damage extending to the metal substrate shall be repainted with primer and finish coat. These coats of paint shall be applied at a dry film thickness as recommended by the paint manufacturer for such repair application.

**657-4 METHOD OF MEASUREMENT.** The unit of measurement for this work is lump sum.

**657-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

**657-5.01 Progress Payments.** Progress payments will be made based on the ratio of area cleaned and painted to the total area to be painted as described in the contract documents.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
657.01nnnn	Painting Weathered Galvanized Surfaces	Lump Sum
657.02nnnn	Painting Newly Galvanized Surfaces	Lump Sum
657.03nnnn	Painting Aluminum Surfaces	Lump Sum

\*nnnn Serialized number identified structure detailed in contract documents.

## **SECTION 658 - WATER WELLS**

**658-1 DESCRIPTION.** The work in this section shall include work required for well drilling

**658-2 MATERIALS.** Materials shall be as specified in the special specifications.

**658-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**658-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**658-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 659 - TELECOMMUNICATION UTILITIES**

**659-1 DESCRIPTION.** The work in this section shall include special construction required for telecommunications service utilities, including telephone, cellular telephone and cable television that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

**659-2 MATERIALS.** Materials shall meet the requirements specified by the respective utility company.

### **659-3 CONSTRUCTION DETAILS**

**659-3.01 General.** The installation and testing procedures shall conform to the requirements specified by the utility company.

**659-3.02 Schedule of Work.** Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

**659-3.03 Excavation.** The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

**659-3.04 Backfill.** The requirements specified in Section 203, *Select Granular Fill* , shall apply.

**659-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**659-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 660 - UTILITIES**

**660-1 DESCRIPTION.** The work in this section shall include special construction required for service utilities that are publicly, privately or cooperatively owned. The extent of work, and construction specifications will be covered by special provisions in the contract documents.

**660-2 MATERIALS.** Materials shall meet the requirements specified by the respective utility company.

### **660-3 CONSTRUCTION DETAILS**

**660-3.01 General.** The installation and testing procedures shall conform to the requirements specified by the utility company.

**660-3.02 Schedule of Work.** Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified, advance notice, period must be given to the utility company and Engineer prior to interruption of services for construction.

**660-3.03 Excavation.** The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

**660-3.04 Backfilling.** The requirements specified in Section 203, *Select Granular Fill* , shall apply.

**660-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**660-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 661 - ELECTRIC UTILITIES**

**661-1 DESCRIPTION.** The work in this section shall include special construction required for electric service utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

**661-2 MATERIALS.** Materials shall meet the requirements specified by the respective electric utility company.

### **661-3 CONSTRUCTION DETAILS**

**661-3.01 General.** The installation and testing procedures shall conform to the requirements specified by the electric utility company.

**661-3.02 Schedule of Work.** Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

**661-3.03 Excavation.** The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

**661-3.04 Backfill.** The requirements specified in Section 203, *Select Granular Fill* , shall apply.

**661-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**661-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 662 - GAS, OIL & STEAM UTILITIES**

**662-1 DESCRIPTION.** The work in this section shall include special construction required for gas, oil and steam service utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

**662-2 MATERIALS.** Materials shall meet the requirements specified by the respective utility company.

### **662-3 CONSTRUCTION DETAILS**

**662-3.01 General.** The installation and testing procedures shall conform to the requirements specified by the utility company.

**662-3.02 Schedule of Work.** Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified, advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

**662-3.03 Excavation.** The requirements specified in Section 206, Trench, Culvert and Structure Excavation, shall apply.

**662-3.04 Backfill.** The requirements specified in Section 203, *Select Granular Fill* , shall apply.

**662-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**662-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 663 - WATER SUPPLY UTILITIES**

**663-1 DESCRIPTION.** This work shall consist of the construction or reconstruction of water supply utilities in accordance with these specifications, the contract documents and the standard sheets.

## **663-2 MATERIALS**

**663-2.01 General.** Materials requirements are specified in the following subsections:

Portland Cement Concrete	501
Reinforced Concrete Pipe Classes II, III, IV, V	706-02
Prefabricated Adjustment Rings, Frames and Utility	
Valve Risers for Drainage Units, Manholes and Utilities	715-13
High Strength Bolts, Nuts and Washers	715-14
Pins and Rollers	715-15
Stainless Steel Connecting Products	715-16
Ductile Iron Water Pipe, Fittings and Encasement	722-01
Steel Water Pipe and Fittings	722-02
Concrete Water Pipe	722-03
Water Valves and Hydrants	722-04
Plastic Water Pipe and Fittings	722-05
Water Service Pipe, Service Valves and Fittings	722-06
Wedge Type Mechanical Restraint Glands	722-07
Insulation for Water Mains	722-08
Steel Pipe	ASTM A53

Materials for water systems shall meet the appropriate American Water Works Association (AWWA) standards and American National Standards Institute (ANSI) specifications, except as modified by these specifications. Asbestos cement pipe or lead tipped gaskets shall not be used. The materials provided shall meet the requirements specified in the “Owner Requirements for Water Mains and Appurtenances”.

**663-2.02 Concrete.** All concrete for thrust blocks and cradles for water mains shall meet the requirements of Class A Concrete in Section 501, Portland Cement Concrete General, except that the requirements for inspection facilities, automated batching controls and recordation will not apply. Class A concrete for thrust blocks and cradles, or other concrete that comes into contact with ductile iron or cast iron materials for water mains, including pipe, fittings, hydrants, valves and valve boxes shall not contain fly ash. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department, or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

## **663-3 CONSTRUCTION DETAILS**

**663-3.01 General.** All work shall be done in accordance with applicable AWWA standards, the plans and specifications, and shall be completed to the satisfaction of the Engineer. Owner requirements will be specified in the contract documents under the special notes “Owner Requirements for Water Mains and Appurtenances”. The Contractor shall make all necessary arrangements, obtain all local permits, and pay all charges as required to satisfy the requirements and regulations of the system Owner. Any required health agency permits will be obtained by the system Owner. The local fire department shall be notified by the Contractor a minimum of forty-eight (48) hours prior to interruption of service to any existing hydrant and within twenty-four (24) hours after a hydrant is placed into service. The Contractor shall notify the Owner, in writing, of any hydrant installed with the drain hole plugged.

The locations of the existing mains as shown on the contract plans are often approximate, as indicated by the underground utility quality level designation. Where new water main connections, not including

service connections of 2 inch diameter pipe and smaller, to existing facilities are proposed, existing utility type, size and/or condition shall be determined by excavating test pits prior to the start of installation. The Contractor shall submit details for connecting existing pipe(s) to the proposed main(s) and drawings or catalog cuts of water pipes and appurtenances comprising the work to the Engineer, with sufficient time to allow for local approval, prior to ordering materials. At any time pipe laying is not in progress, the open ends of the working pipe shall be kept plugged and watertight with plugs, stoppers or other means acceptable to the Engineer.

The Engineer shall be notified immediately of the discovery of any suspected asbestos-containing water supply utilities not identified in the contract documents. Any asbestos-containing water supply utility not identified in the contract documents and encountered during the work shall not be disturbed. No cutting, grinding or any disturbance of asbestos-containing utility shall be performed under the items in this section.

**663-3.02 Removals.** Removal of existing water main shall include the removal of all appurtenances and fittings within the trench excavation width for that size pipe as shown on the standard sheets, except that an existing concrete thrust block need not be removed unless its presence will interfere with proposed work. Existing items requiring removal and disposal shall become the property of the Contractor and shall be removed from the work site to the satisfaction of the Engineer. Existing items requiring removal and storage shall be removed and stored by the Contractor for pick up by the Owner. The Contractor shall exercise care in removing items to be stored to prevent damage. Unusable or unwanted material shall be disposed of by the Contractor. Removal of an existing water service connection shall include the removal of the service pipe from the main to the highway boundary or other location(s) shown in the contract documents and the removal of the curb stop and curb box. Unless otherwise noted in the Owner requirements, corporation stops shall be removed and the hole plugged with a solid brass or iron plug.

*Disturbance of asbestos-containing water supply utility requires use of a New York State Department of Labor (NYSDOL) licensed contractor using NYSDOL certified asbestos handlers. Removal of asbestos-containing water supply utility encountered during excavation or exploration shall not be performed under the removal items contained in this section.*

**663-3.03 Shutdowns.** A shutdown of any portion of a water system to make connections to existing mains shall be made with the consent of the system Owner. Approvals for shutting off a water service shall be obtained from the Engineer. The Contractor shall give a minimum of forty-eight (48) hours notice to each customer prior to interruption of service, unless the system Owner requires a longer notification period. Such notice may be provided by posting a written notice at the entrance to the building from the street. When a residential service is to be interrupted for more than eight (8) hours, the Contractor shall, when directed by the Engineer, provide a temporary water service. When a commercial service is to be interrupted for more than 60 minutes during the establishment's normal business hours, the Contractor shall, when directed by the Engineer, provide a temporary water service. A temporary water service shall be required only when specified in the plans, or when directed by the Engineer, and will then be paid for under the Temporary Water Service item.

**663-3.04 Excavation and Backfill.** Unless modified by contract documents, the requirements of section 206 *Trench, Culvert and Structure Excavation* shall apply except for trench widths for which the standard sheet – “*Water Main Pipe Installation Details*” shall apply. The payment width of trench excavation shall be as shown on the standard sheet for this section. Bell holes shall be excavated no larger than required to allow joint assembly and to allow the pipe to lay flat in the trench. Trenches for pipe sizes from 3 to 24 inch diameter shall provide a minimum of 6 inch clearance to rocks or boulders and trenches for pipe sizes from 30 to 64 inch diameter shall provide a minimum of 9 inch

clearance to rocks or boulders. Longitudinal excavation and backfill limits shall be 3 feet beyond the connection or termination point with an existing main, and 2 feet beyond the barrel of a hydrant.

The Contractor shall meet the requirements of Section 203, *Select Granular Fill*. Materials containing fly ash or slag, including Controlled Low Strength Material that contains flyash, shall not be used as backfill or allowed to come into contact with ductile iron or cast iron materials for water mains, including pipe, fittings, hydrants, valves and valve boxes. Bedding and embedment material used for backfill around plastic pipe shall have a maximum particle size of 3/4 inch.

**663-3.05 Thrust Restraint.** Thrust forces produced in water mains at changes in direction or size shall be restrained in order to keep the main intact. Thrust restraint may be provided by restrained joints, retainer glands, thrust blocks or tie rods, as required by the Owner. The minimum required thrust block areas and volumes shown on the standard sheet are for a standard water system test pressure, soil bearing capacity and soil unit weight. These values shall be adjusted for higher water system test pressure requirements or different soil conditions in the field. The Contractor shall be responsible for providing the proper size and type of thrust restraint, based on the standard sheets, the Owner requirements and the contract plans. Thrust restraint for sizes larger than 24 inch diameter pipe will be designed on a case by case basis, and will be shown in the contract documents.

#### **663-3.06 Pipe.**

**A. General.** Pipe shall be laid in close conformity to line and grade having a full, firm and even bearing at each joint and along the entire length of pipe. Pressurized pipe need not be laid with the bells upstream. Only gaskets certified by the Manufacturer for use with the type of pipe or fitting installed shall be used. Existing gray iron pipe shall be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw or a hydraulic squeeze cutter. The Contractor shall repair, realign or replace pipe that is damaged or disturbed through any cause occurring prior to acceptance of the contract. Pipe which is defective from any cause, including damage caused by handling and determined by the Engineer to not be repairable, will be unacceptable for installation and shall be replaced as directed by the Engineer at no cost to the State.

**B. Ductile Iron Cement Lined Water Pipe.** Ductile iron water mains shall be installed in accordance with AWWA Standard C600.

Unless otherwise noted in the Owners requirements, ductile iron pipe up to 12 inch diameter shall be pressure class 350 or thicker, and the cement lining shall be 1/16 inch thick.

Unless otherwise noted in the Owners requirements, ductile iron pipe from 14 to 24 inch diameter shall be pressure class 250 or thicker, and the cement lining shall be 3/32 inch thick. Unless otherwise noted in the Owners requirements, ductile iron pipe from 30 to 64 inch diameter shall be pressure class 250 or thicker and the cement lining shall be 1/8 inch thick. Ductile iron pipe joints shall be installed with deflections not exceeding that listed in the table on the standard sheet. Ductile iron pipe selected for cutting shall be field gauged in order to ensure that after smoothing and beveling (if required), the cut end will provide a sound joint. Ductile iron pipe shall be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw. Ductile iron pipe shall be cut with an oxyacetylene torch only when recommended by the Manufacturer and approved by the Engineer. Cut ends and rough edges shall be ground smooth. Cut ends shall be beveled if using push-on joints. The Contractor shall ensure that the cement mortar lining of ductile iron pipe is not damaged during cutting operations.

**C. Steel Water Pipe.** Steel water pipe shall be installed in accordance with the contract documents and the Owner requirements. Steel pipe may be cut with an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw or milling wheel saw. Steel pipe shall be welded in accordance with AWWA Standards and with the provisions of the "NYS Steel Construction Manual". Fittings for steel pipe

shall be shop fabricated in accordance with AWWA Standard C208. Linings and coatings shall be installed in accordance with the appropriate AWWA Standard for the specified material.

**D. Concrete Water Pipe.** Concrete water pipe shall be installed in accordance with the contract documents and the Owner requirements.

**E. Plastic Water Pipe.** Plastic water mains shall be installed in accordance with AWWA Standard C605. Unless otherwise noted in the Owners requirements, plastic water pipe shall be pressure class 150. Plastic water pipe may be cut with a hand saw, circular saw or similar equipment. After cutting plastic water pipe, ends shall be smoothed or beveled similar to factory ends to provide sound joint connections.

Plastic water pipe shall be re-marked with an insertion line to allow proper joint make-up. Unless otherwise noted in the Owners requirements, plastic water pipe shall be installed with a coated tracing wire above the pipe to facilitate location. A portion of the wire shall be stripped and firmly connected to valves, hydrants, corporation stop and curb stops to provide electrical connectivity.

**F. Bridge Mounted Water Pipe.** Water pipe shall be installed on a bridge in accordance with the contract plans. This shall include, but is not limited to, expansion devices, rollers, chairs, connectors, insulation, insulation covering and sleeves.

**G. Handling and Assembly of Pipe.** Pipe and fittings shall be inspected prior to placement. The inside of pipe, fittings and existing water mains shall be kept free of dirt and foreign material. If dirt or potentially contaminated water has entered the inside of a water main, the main shall be cleaned and disinfected prior to placement to facilitate the disinfection process on the completed installation. Pipe and fittings shall be lowered into place, and shall not be rolled, dropped or allowed to fall into a trench or pit.

### **663-3.07 Polyethylene Encasement and Insulation.**

**A. Polyethylene Encasement.** When called for in the contract documents, ductile-iron pipe shall be polyethylene encased in accordance with the methods outlined in AWWA Standard C105.

**B. Insulation for Buried Water Pipe.** When called for in the contract documents, insulation shall be installed in accordance with the contract plans and the Manufacturer's recommendations. Insulation for underground installation shall use appropriate material or be covered with an appropriate waterproof jacket or insulator, as specified in the Owner requirements.

### **663-3.08 Valves & Valve Boxes.**

**A. General.** Valves shall have an asphaltic or epoxy coating as required under AWWA Standard C509 or C515. Valves shall open in the direction specified in the Owner requirements. Valves shall be lowered into place, and shall not be rolled, dropped or allowed to fall into a trench or pit. Valves shall not be lifted or moved by the valve stem.

**B. Valve Installation.** Valves shall be installed where shown on the contract plan during the progress of the pipe laying. Valves shall be laid with full, firm and even bearing. Bearing shall be provided by concrete blocks, or a minimum of 6 inches of well-compacted granular fill or crushed stone, as required in the Owner requirements or as shown on the plans.

**C. Handling of Removed or Relocated Valves.** All valves shown on the plans to be removed or relocated shall be carefully detached, cleaned and stored in locations acceptable to the Engineer

within the job site. The Contractor shall take special precautions to prevent damage to the valve during disconnection, movement and reinstallation.

**D. Valve Relocation.** Valves shall be removed from the existing location, checked, all foreign material removed from the interior and placed in operating condition before reinstallation. Exterior rust and corrosion shall be removed and the valve exterior recoated with an asphaltic coating prior to installation.

**E. Valve Boxes.** Unless otherwise noted in the Owner requirements, valve boxes shall be slide type adjustable, set plumb over the center of the valve and to the proper grade. Any valve box which has moved sufficiently from the original position so as to prevent the application of the valve key shall be reset by the Contractor at no additional cost to the State. New valve box covers shall be cast with the word "WATER" on the top as a means of identification.

### **663-3.09 Hydrants.**

**A. General.** Each hydrant shall include bonnet, upper barrel, lower barrel and shoe with all internal operating parts. Hydrants shall be dry-barrel, traffic type, incorporating a frangible connection on the hydrant barrel or at the groundline joint and on the operating rod. The outside of the hydrant upper barrel shall be painted with a minimum of one coat of primer and one finish coat of industrial enamel in the color noted in the Owner requirements or to match existing hydrants if not noted. Unless otherwise noted in the Owner requirements, all hydrants shall have a 5 inch diameter main valve and be equipped with a 4 1/2 NST steamer nozzle and two 2 1/2 NST hose nozzles. Non-operational hydrants shall be bagged or covered, in a manner acceptable to the Engineer, until they are tested and placed in service.

**B. Hydrant Installation.** Hydrants shall be installed during the laying of pipe. Hydrants shall be restrained, typically from the main to the hydrant shoe, using one of the methods outlined under §663-3.05 "Thrust Restraint". Hydrants shall be set plumb at the proposed locations. The groundline marked on the hydrant, or identified by the manufacturer using an offset from a point on the hydrant, shall be within 1 inch above or below finished grade. The hydrant shall be installed so that no portion of the lower barrel, (that portion remaining if the hydrant top is broken off) extends more than 4 inches above grade. The measurement will be taken over a 5 feet horizontal span when a change in grade occurs within 5 feet of the hydrant. Hydrant drainage material meeting the specifications of §703-02, Table 703-4, Size Designation 1 or 2, shall be placed around the hydrant at the drip location (1/4 cubic yard minimum) to drain the barrel, except as noted on the standard sheets or the contract plans. Hydrant barrels shall be rotated so that the steamer nozzle is facing the roadway, unless otherwise noted in the contract documents.

**C. Handling of Removed or Relocated Hydrants.** All hydrants shown on the plans to be removed or relocated shall be carefully detached, cleaned and stored in locations designated by the Engineer within the job site. The Contractor shall take special precautions to prevent damage to the hydrant assembly during disconnection, movement and reinstallation.

**D. Hydrant Relocation.** Hydrants shall be removed from the existing location, checked, all foreign material removed from the interior of the barrel and placed in operating condition before reinstallation. Exterior rust and corrosion shall be removed and the hydrant repainted the color specified by the Owner prior to reinstallation. When the hydrant is ready for service, the hydrant shall be opened and closed to verify that all parts are in working condition. The barrel interior shall be inspected for proper drainage after reinstallation is completed.



**663-3.10 Hydrant Fenders.** Fenders shall be installed where shown on the contract plans, in accordance with the standard sheets.

**663-3.11 Dry Hydrants.** Dry hydrants shall be furnished and installed in accordance with the contract documents.

**663-3.12 Tapping Sleeve, Valve & Valve Boxes and Line Stop & Tapping Fittings.** Fittings shall be installed in accordance with the Manufacturers recommendations. All valves shall be installed in accordance with the requirements of §663-3.08.

**663-3.13 Bolted, Sleeve Type Couplings.** All couplings shall meet the requirements of AWWA Standard C219.

**663-3.14 Iron Water Main Fittings.** All fittings shall be compact ductile iron (AWWA C153) unless specifically required otherwise in the Owner requirements. When approved by the Owner, the Contractor may provide a comparable full body fitting (AWWA C110) when not specifically required.

**663-3.15 Wedge Type Mechanical Restraint Glands.** Glands shall be installed in accordance with the Manufacturer’s recommendations, using break away wedge bolts. If a gland needs to be moved or adjusted, the Contractor shall reinstall the wedges using a torque indicating wrench to within the torque range recommended by the Manufacturer.

**663-3.16 High Deflection Restrained Joint Fittings.** All fittings shall be compact ductile iron (AWWA C153) unless specifically required otherwise in the Owner requirements.

**663-3.17 Water Service Connections.** A water service connection shall include the installation of everything, except water service pipe, required to provide a connection from a main to a customer at the highway boundary, including corporation stop, curb stop, curb box, tapping sleeve or saddle, if required, and all necessary fittings.

Taps should be a minimum of 24 inches from a pipe end. Multiple taps should be a minimum of 18 inches apart, measured along the axis of the main. If taps are made at the 2 or 10 o’clock positions, the Contractor shall ensure that the high point in the water service pipe meets the minimum cover requirement. Taps greater than 2 inch diameter shall be made using a tapping sleeve and valve.

For ductile iron pipe, unless otherwise noted in the Owner requirements, maximum allowable direct tap sizes shall be as shown in Table 663-1. For plastic pipe, unless otherwise noted in the Owner requirements, taps up to 1 inch diameter may be directly tapped into a main, and taps from 1 1/4 to 2 inch diameter shall be tapped using a tapping saddle.

<b>TABLE 663-1 MAXIMUM ALLOWABLE DIRECT TAP SIZE FOR DUCTILE IRON PIPE (inches)</b>			
<b>Pipe Size (inches)</b>	<b>Pressure Class</b>		
	<b>250</b>	<b>300</b>	<b>350</b>
4	--	--	3/4
6	--	--	1
8	--	--	1
10	--	--	1
12	--	--	1-1/4
14	1-1/4	1-1/2	1-1/2

16	1-1/2	2	2
18	2	2	2
20	2	2	2
24	2	2	2

**NOTE:** All thickness class sizes of ductile iron pipe may be direct tapped.

Unless otherwise noted in the Owner requirements, water service pipe shall be Type K copper. Unless otherwise noted in the Owner requirements, polyethylene water service pipe shall be installed with a coated tracing wire to facilitate location. A portion of the wire shall be stripped and firmly connected to the corporation stop and the curb stop to provide electrical connectivity.

The Contractor will have the option to install water service pipe using boring, drilling or other trenchless method. Trenchless installation shall be performed in a manner acceptable to the Engineer. Water service pipe installed using a trenchless method shall be installed in a single length free of couplings or other fittings over that length.

**663-3.18 Water Meter Pits, Type A.** All pits shall be furnished in accordance with details in the contract documents and the Owner requirements. Type A pits are concrete or masonry structures capable of holding water meters and valves, and allow personnel entry for service and repair. Unless otherwise noted in the Owner requirements, meters to be installed in water meter pits will be supplied by the Owner at no cost to the Contractor or to the State.

**663-3.19 Water Meter Pits, Type B.** All pits shall be furnished and installed in accordance with the standard sheets and the Owner requirements. Unless otherwise noted in the Owner requirements, meters to be installed in water meter pits will be supplied by the Owner at no cost to the Contractor or to the State.

**663-3.20 Temporary Water Service for Water Main Installation.** The Contractor shall, when called for in the contract documents or directed by the Engineer, provide temporary water service to customers during interruptions caused by water main work. The service may be provided by temporary piping or other method approved by the Engineer.

**663-3.21 Adjust Valve Box Elevation.** Prior to the placement of the top course and after the placement of the binder course, when required, the Contractor shall install adjustment rings or frames for valve boxes. The Contractor shall be responsible for ensuring that the adjustment rings or frames are compatible with the existing valve boxes. The adjustment ring or frame shall be placed so the valve box cover will not protrude above the finished surface of the pavement, and is no more than 3/16 inch below finished grade. The Contractor shall have the option of resetting the existing valve box to the required grade.

To ensure a firm and secure fit with the adjustment ring or frame, the seat of the existing valve box shall be free of all foreign material at the time of installation. The entire assembly shall be set on the seat of the existing valve box and secured. The valve box cover shall then be set upon the seat of the adjustment ring or frame. All rings or frames shall be protected from displacement caused by traffic maintained on the roadway or equipment used in the paving operation.

**663-3.22 Disconnect and Cap Existing Water Main.** Existing water main shall be disconnected and capped in accordance with the contract documents.

**663-3.23 Hydrostatic Testing.** Hydrostatic pressure and leakage tests shall be performed in accordance with AWWA C600. Prior to formal testing, the mains shall be thoroughly flushed. Hydrostatic pressure and leakage tests shall be made on installations (water mains, valves, fittings, etc.) having diameters larger than 2 inches. The testing shall include any filling points, sampling points or other appurtenances

required to conduct the tests. The total leakage per day shall not exceed the amounts allowable under AWWA C600. Unless otherwise noted in the Owner requirements, the system shall be subjected to the pressure/leakage test with water under a hydrostatic pressure of 150 psi for two (2) hours.

**663-3.24 Disinfection.** Upon completion of all water supply related construction, all mains, valves, hydrants and other appurtenances built under this contract shall be flushed, disinfected and tested for bacteriological quality in accordance with AWWA C651. Tablets shall not be used for chlorination of solvent welded plastic or screwed-joint steel pipe due to danger of fire or explosion from the reaction of joint compounds with calcium hypochlorite.

#### **663-4 METHOD OF MEASUREMENT**

**663-4.01 Water Pipe.** The quantity to be measured for payment will be in feet of laying length to the nearest 1/2 foot. The measurement for pipe will not include the length of fittings.

**663-4.02 Water Service Pipe.** The quantity to be measured for payment will be in feet of laying length to the nearest whole foot. The measurement for pipe will not include the length of fittings.

**663-4.03 Steel Pipe Bends and Fittings.** Steel pipe bends and fittings will be measured in feet of equivalent lengths of steel pipe, to the nearest 1/2 foot. The length of bends will be the length of the circular arc using the angle of the bend and the radius of bend used to make the desired connection. The length of special fittings for steel pipe will be the length along the centerline from an intersecting centerline, as in a tee or wye. The lengths may be measured for different diameters on a tee or wye having legs of unequal diameter. Refer to AWWA Standard C208, Figure 1 and Table 1 for lengths.

**663-4.04 Bridge Mounted Water Pipe.** The quantity to be measured for payment will be in feet to the nearest 1/2 foot from a point 5 feet behind the back surface of each structure abutment or backwall, or to points indicated in the contract documents for installations that do not pass through an abutment or backwall.

**663-4.05 Valve & Valve Boxes.** The quantity to be measured for payment will be the number of units of each size furnished and incorporated into the work in accordance with the contract documents.

**663-4.06 Hydrants.** The quantity to be measured for payment will be the number of units furnished and incorporated into the work in accordance with the contract documents.

**663-4.07 Hydrant Fenders.** The quantity to be measured for payment will be the number of fenders furnished and incorporated into the work in accordance with the contract documents.

**663-4.08 Dry Hydrants.** The quantity to be measured for payment will be the number of dry hydrants, including all necessary pipe and fittings furnished and incorporated into the work in accordance with the contract documents.

**663-4.09 Tapping Sleeve, Valve & Valve Boxes; Line Stop and Tapping Fittings; and Bolted, Sleeve Type Couplings.** The quantity to be measured for payment will be the number of units of each size furnished and incorporated into the work in accordance with the contract documents.

**663-4.10 Iron Water Main Fittings.** The quantity to be measured for payment will be the bare weight of fittings installed, as listed in AWWA Standard C110 or C153, as applicable. Total contract quantity will be measured to the nearest whole pound. No measurement will be made for the weight of gaskets, other appurtenant hardware, retainer glands provided solely for thrust restraint or thrust restraints rods.

The quantity measured for payment for fittings not listed in the AWWA Standards will be based upon Manufacturer certifications.

**663-4.11 Wedge Type Mechanical Restraint Glands and High Deflection Restrained Joint Fittings.**

The quantity to be measured for payment will be the number of units furnished and incorporated into the work in accordance with the contract documents.

**663-4.12 Polyethylene Encasement for Water Mains and Insulation for Water Mains.** The quantity to be measured for payment will be the number of feet along the pipe axis measured to the nearest whole foot furnished and incorporated into the work in accordance with the contract documents.

**663-4.13 Water Service Connections and Curb Stop & Curb Box.** The quantity to be measured for payment will be the number of complete units furnished and incorporated into the work in accordance with the contract documents.

**663-4.14 Water Meter Pits, Type A and Water Meter Pits, Type B.** The quantity to be measured for payment will be the number of complete units furnished and incorporated into the work in accordance with the contract documents.

**663-4.15 Temporary Water Service for Water Main Installation.** Payment for Temporary Water Service for Water Main Installation will be made on a lump sum basis.

**663-4.16 Relocate Existing Water Valve & Valve Box, Relocate Existing Hydrant Assembly and Relocate Existing Curb Stop & Curb Box.** The quantity to be measured for payment will be the number of units of each relocated in accordance with the contract documents.

**663-4.17 Adjust Existing Valve Box Elevation, Adjust Existing Hydrant Elevation and Adjust Existing Curb Box Elevation.** The quantity to be measured for payment will be the number of units of each adjusted in accordance with the contract documents.

**663-4.18 Disconnect and Cap Existing Water Main.** The quantity to be measured for payment will be the number of mains disconnected and capped in accordance with the contract documents.

**663-4.19 Remove and Dispose of Existing Water Main.** The quantity to be measured for payment will be in feet along the pipe axis measured to the nearest whole foot in accordance with the contract documents.

**663-4.20 Remove and Dispose of Existing Water Valve & Valve Box and Remove and Dispose of Existing Hydrant.** The quantity to be measured for payment will be the number of units removed and disposed of in accordance with the contract documents.

**663-4.21 Remove and Dispose of Existing Water Service Connection.** The quantity to be measured for payment will be the number of units removed and disposed of in accordance with the contract documents.

**663-4.22 Remove and Store Existing Water Valve & Valve Box and Remove and Store Existing Hydrant.** The quantity to be measured for payment will be the number of units removed and stored in accordance with the contract documents.

**663-5 BASIS OF PAYMENT**

**663-5.01 General.** The unit price bid shall include the cost of all materials, labor and equipment necessary to complete the work, except that test pits, excavation and backfill will be paid for separately. Unless otherwise noted in the contract documents, payment for thrust restraint shall be included in the price bid for pipe and appurtenances. No additional payment will be made for permits, cutting existing mains, thrust restraint, disinfection or testing. Progress payments for installed or relocated items will be made at the unit bid price for 80 percent of the quantity installed, when the installation is completed and backfilled to a minimum of 2 feet over the top of the pipe plus additional cover required to protect the installation from vehicular and construction traffic. The remaining 20 percent will be paid for when required testing and disinfection of the system has been satisfactorily completed.

**663-5.02 Steel Pipe Bends and Fittings.** The payment for steel pipe bends and fittings will be made under the steel water pipe item for equivalent lengths of steel pipe. The payment item for a reducer will be based on the larger diameter.

**663-5.03 Bridge Mounted Water Pipe.** The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work, including, but not limited to, expansion devices, rollers, chairs, connectors, insulation, insulation covering and sleeves, except that structural utility support members will be paid for under a structural steel item.

**663-5.04 Water Service Pipe.** The unit price bid for plastic pipe and polyethylene water service pipe will include the installation of tracing wire, if required. If the Contractor opts to install water service pipe using a trenchless method, excavation and backfill will be paid for as if the standard installation method had been used. No additional payment will be made for surface restoration not required due to use of trenchless installation.

**663-5.05 Hydrants.** The unit price bid for each hydrant shall include a length or lengths of anchor pipe, installed at any point between the main and the hydrant up to 6 1/2 feet long at no additional cost to the State. Hydrant drainage material will be included in the payment for each hydrant at no additional cost to the State.

**663-5.06 Hydrant Fenders.** The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work. The work shall include excavation for the fenders, installation and backfill. The excavation for the concrete collars and slabs and the concrete required will be paid for separately.

**663-5.07 Bolted, Sleeve Type Couplings.** If a bolted coupling is used to join two different diameters of pipe, the payment item will be based on the larger size.

**663-5.08 Iron Water Main Fittings.** Payment for a full body (AWWA C110) fitting provided but not required will be the weight of a similar compact (AWWA C153) fitting. The payment item for a fitting with different size connections will be based on the largest diameter size on that fitting (i.e. a 12 x 4 inch diameter Tee will be in the 10 - 16 inch diameter range).

**663-5.09 Water Service Connections.** Payment for a water service connection will include the cost of all labor, materials and equipment necessary to complete the installation of everything required to provide a connection from a main to a customer at the highway boundary, including corporation stop, curb stop, curb box, tapping sleeve or saddle, if required, and all necessary fittings, except the service pipe, which will be paid for separately.

**663-5.10 Water Meter Pits.** The unit price bid shall include the cost of all labor, materials, including meter pit lids, covers and steps, and equipment necessary to complete the work.

**663-5.11 Relocate Existing Hydrant.** The unit price bid for each hydrant relocation shall include a length of lateral pipe up to 6 1/2 feet long, installed at any point between the main and the hydrant and hydrant drainage material at no additional cost to the State.

**663-5.12 Adjust Existing Valve Box Elevation and Adjust Existing Curb Box Elevation.** If the Contractor elects to reset the existing valve box, the costs of the work involved in the removal and replacement of existing disturbed pavement shall be included in the bid price for adjustment of the valve box.

**663-5.13 Adjust Existing Hydrant Elevation.** The unit price bid for each hydrant elevation adjustment shall include the cost of any barrel extensions required to complete the work at no additional cost to the State.

**663-5.14 Disconnect and Cap Existing Water Main.** Any fittings required to complete the work will be paid for separately.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
663.01xx	Ductile Iron Cement Lined Water Pipe	Foot
663.02xx	Steel Water Pipe	Foot
663.03xx	Concrete Water Pipe	Foot
663.04xx	Plastic Water Pipe	Foot
663.05xx	Bridge Mounted Water Pipe	Foot
663.06zz	Copper Water Service Pipe	Foot
663.07zz	Polyethylene Water Service Pipe	Foot
663.08zz	Steel Water Service Pipe	Foot
663.10xx	Resilient Wedge Valve & Valve Box	Each
663.11xx	Butterfly Valve & Valve Box	Each
663.12xx	Double Disk Gate Valve & Valve Box	Each
663.13nn	Hydrant	Each
663.14	Hydrant Fender	Each
663.15nn	Dry Hydrant	Each
663.16xxyy	Tapping Sleeve, Valve & Valve Box Assembly	Each
663.17xx	Line Stop Fitting	Each
663.18xx	Bolted, Sleeve Type Coupling	Each
663.2001	Iron Water Main Fittings (3 - 8 inch diameter)	Pound
663.2002	Iron Water Main Fittings (10 - 16 inch diameter)	Pound
663.2003	Iron Water Main Fittings (18 inch diameter and larger)	Pound
663.21xx	Wedge Type Mechanical Restraint Glands (xx inch diameter)	Each
663.22xx	High Deflection Restrained Joint Fitting (xx inch diameter)	Each
663.23xx	Polyethylene Encasement for Water Pipe	Foot
663.24xxgg	Insulation for Buried Water Pipe (xx inch diameter with gg Thick Insulation)	Foot
663.25zz	Water Service Connection	Each
663.26zz	Curb Stop & Curb Box	Each
663.27nn	Water Meter Pit, Type A	Each
663.28nn	Water Meter Pit, Type B	Each
663.29nn	Temporary Water Service for Water Main Installation	Lump Sum
663.30	Relocate Existing Water Valve & Valve Box	Each
663.31	Relocate Existing Hydrant	Each

663.32	Relocate Existing Curb Stop & Curb Box	Each
663.33	Adjust Existing Valve Box Elevation	Each
663.34	Adjust Existing Hydrant Elevation	Each
663.35	Adjust Existing Curb Box Elevation	Each
663.40	Disconnect and Cap Existing Water Main	Each
663.41xx	Remove and Dispose of Existing Water Main	Foot
663.42	Remove and Dispose of Existing Water Valve & Valve Box	Each
663.43	Remove and Dispose of Existing Hydrant	Each
663.44	Remove and Dispose of Existing Water Service Connection	Each
663.45	Remove and Store Existing Water Valve & Valve Box	Each
663.46	Remove and Store Existing Hydrant	Each
663.47	Remove and Store Existing Curb Stop & Curb Box	Each

*gg = Insulation Thickness Code*

*nn = Serialized item*

*xx = diameter, inches*

*yy = diameter, inches*

*zz = Water Service Size, 01 = 1/2", 02 = 5/8" (not available in steel), 03 = 3/4",  
04 = 1", 05 = 1-1/4", 06 = 1-1/2", 07 = 2"*

## **SECTION 664 - SANITARY SEWER UTILITIES**

**664-1 DESCRIPTION.** The work in this section shall include special construction required for sanitary sewer utilities that are publicly, privately or cooperatively owned. The extent of work and construction specifications will be covered by special provisions in the contract documents.

**664-2 MATERIALS.** Materials shall meet the requirements specified by the respective utility company.

### **664-3 CONSTRUCTION DETAILS**

**664-3.01 General.** The installation and testing procedures shall conform to the requirements specified by the utility company.

**664-3.02 Schedule of Work.** Work shall be scheduled for minimum interruption of service and must meet the approval of the utility company and the Engineer. A specified advance notice period must be given to the utility company and Engineer prior to interruption of services for construction.

**664-3.03 Excavation.** The requirements of section 206 *Trench, Culvert and Structure Excavation* shall apply except for trench widths for which standard sheet "*Sanitary Sewer Main Pipe Installation Details*" shall apply.

**664-3.04 Backfill.** The requirements specified in Section 203, *Select Granular Fill*, shall apply.

**664-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**664-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 665 - WATERWAYS**

**665-1 DESCRIPTION.** The work in this section shall include special construction required for the New York State Canal Corporation.

The extent of work, material required, construction details, method of measurement and basis of payment will be covered by special provisions in the contract documents.

## SECTION 666 (VACANT)

## SECTION 667 - LOCAL ROAD GRAVEL SURFACE, BASE, AND SUBBASE COURSES (Last Revised September, 2016)

### 667-1 DESCRIPTION.

**667-1.01 General.** The work consists of furnishing, placing and compacting gravel surface, base and subbase courses in conformity with the lines, grades, thicknesses and typical sections shown on the plans, or as determined by field conditions and ordered in writing by the municipality.

**667-1.02 Material Types.** Provide materials as specified by the following options.

*Surface Course.* Surface quality material with a maximum particle size of 1 inch.

*Base Course.* Base quality material with a maximum particle size of 2 inches.

*Subbase Course.* Subbase quality material with a maximum particle size of 3 inches.

### 667-2 MATERIALS.

**667-2.01 Test and Control Methods.** All tests shall be performed by laboratories accredited under the AASHTO accreditation program. Materials tests and quality control methods pertaining to the work of this section will be performed in conformance with the procedures contained in the appropriate New York State Department of Transportation (NYSDOT) and/or American Association of State Highway and Transportation Officials (AASHTO) publications which are current on the date of advertisement of bids.

**667-2.02 Materials Requirements.** Provide materials for road gravel surface, base, and subbase courses that consist of Sand and Gravel, approved Blast Furnace Slag or Stone that meet the requirements contained herein. Provide materials well graded from coarse to fine, and free from organic or other deleterious materials. Any gravel material will be rejected if it is determined to contain any unsound or deleterious materials.

**A. Gradation.** Perform sieve analysis in accordance with the AASHTO procedures T 27, T 88 or T 311. Report the following sieves for all tests: # 200, # 40, ¼ inch, ½ inch, ¾ inch, 1 inch, 1 ½ inch, 2 inch, 3 inch.

Provide material meeting the gradation limits from Table 667-1.

**B. Soundness.** Material for local road gravel surface, base, and subbase courses will be accepted on the basis of Magnesium sulfate Soundness Loss after four (4) cycles performed according to NYSDOT procedures and Table 667-2.

**C. Plasticity.** Determine plasticity using the following method:



**1. Plasticity Index.** The Plasticity Index of the material passing the #40 mesh sieve shall meet the values in Table 667-2. Determine plasticity using AASHTO tests T 89 or T 90.

<b>TABLE 667-1 PERCENT PASSING BY WEIGHT OF GRAVEL MATERIALS</b>			
<b>Sieve (U.S. sieve)</b>	<b>Material Type</b>		
	<b>Surface</b>	<b>Base</b>	<b>Subbase</b>
3"			100
2"		100	-
1.5"		85-100	70-100
1"	100	-	-
3/4"	85-100	-	-
1/4"	50-75	30-50	30-55
#40	15-35	5-20	5-25
#200	8-15	0-5	0-8

<b>TABLE 667-2 TEST AND CONTROL LIMITS OF GRAVEL MATERIALS</b>			
<b>Material Properties</b>	<b>Material Type</b>		
	<b>Surface</b>	<b>Base</b>	<b>Subbase</b>
Maximum Soundness loss (%)	20	20	25
Plasticity Index	2-9	0-5	0-8

**D. Elongated Particles.** Not more than 30 percent, by weight, of the particles retained on a ½ inch sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be based on a visual inspection. When the municipality elects to test for this requirement, material with a percentage greater than 30 will be rejected.

**E. Fractured Faces.** When the municipality elects to test for this requirement, Surface Course material shall have at least two fractured faces on 50 percent of the stone particles larger than ½ inch or at least one fractured face on 75 percent of the particles larger than ½ inch. Base Course material shall have at least one fractured face on 50 percent of the stone particles larger than ½ inch.

**667-2.03 Stockpiling.** Stockpile all material in accordance with the geotechnical control procedure “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**667-3 CONSTRUCTION DETAILS.**

**667-3.01 General.** Use uniform gravel types and materials between the roadbed limits.

**667-3.02 Placement.**

A. Place the upper course material on the grade in a manner to minimize segregation, using equipment and procedures approved by the Municipality. Do not perform uncontrolled spreading from piles dumped on the grade.

B. The maximum compacted layer thickness is 15 inches, or as shown on the plans. In confined areas as defined by the Municipality the maximum compacted layer thickness is 6 inches. The minimum loose lift

thickness is 1.5 times the maximum particle size.

**667-3.03 Compaction.** When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements of Section 203, *Compaction*. Density tests are not required for the acceptance of these courses. If a subbase course has been disturbed by frost action prior to placing the next course, recompact the layer.

**667-3.04 Traffic and Contamination.** The movement of highway traffic over the final surface of the base or subbase may be permitted at locations designated by, and under such restrictions as directed by the Municipality, provided such movements take place prior to the final finishing of this course to the specified tolerance. The movement of construction equipment on this course may be permitted at locations designated by and under such restrictions as directed by the Municipality.

No payment will be made for furnishing, placing, maintaining, removing and disposing any protective layer. Include the cost thereof in the price bid.

If a layer is damaged or mixed with the subgrade or any other material due to the Contractor's operation, remove such material and replace it with the appropriate material at no additional cost to the Municipality.

**667-3.05 Tolerance.**

**A. Surface and Base Course.** Place material so that after compaction the top surface of the course does not extend more than ¼ inch above nor more than ¼ inch below true grade for the course at any location.

**B. Subbase Course.** Place material so that after compaction the top surface of the course does not extend more than ½ inch above nor more than ½ inch below true grade for the course at any location.

**667-4 METHOD OF MEASUREMENT.** The quantity is the number of cubic yards of material, computed from payment lines shown on the plans or, where changes has been ordered, from payment lines established by the Municipality.

**667-5 BASIS OF PAYMENT.** The unit price bid for this work includes the cost of furnishing all labor, material and equipment necessary to complete the work. Include the cost of adding water in the price bid unless the items for furnishing and applying water are included in the contract. No direct payment will be made for losses of material resulting from compaction, foundation settlement, erosion, or any other cause. Include the cost of such losses in the price bid for this item. No deductions will be made for the volumes occupied by manholes, catch basins and other such objects.

Progress payments will be made after each Type course has been properly placed and compacted. Payment will be made at the unit price bid for seventy-five (75) percent of the quantity. The balance of the quantity will be paid for after the final finishing to the required tolerance and just prior to the placing of the next course or Type.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
667.01	Local Road Gravel Surface Course	Cubic Yard
667.02	Local Road Gravel Base Course	Cubic Yard
667.03	Local Road Gravel Subbase Course	Cubic Yard

**SECTIONS 668 AND 669 (VACANT)**

**SECTION 670 - HIGHWAY LIGHTING SYSTEM**

(Last Revised September 2021)

**670-1 DESCRIPTION.** This work shall consist of furnishing and installing an operating highway lighting system in accordance with the plans, standard sheets, and specifications or as directed by the Engineer.

Where not specifically covered on the plans, specifications, or special provisions, all equipment shall be installed according to the manufacturer's published recommendations.

Included in this work is the furnishing and installing of metal light standards, breakaway transformer bases, arms, luminaires, lamps, electrical conductors, fittings, minor miscellaneous components (pole line hardware, insulators, etc.), concrete foundations, pull boxes and all other materials necessary for operating and controlling the highway lighting system. Also included is the removal, relocation, storage, and/or disposal of the above materials.

**670-2 MATERIALS.** All electrical equipment shall conform to the EEI, NEMA, ANSI and ASTM Standards. All material shall conform to the latest requirements of the "National Electrical Code", herein referred to as the "Code"; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply. Differences in standards or code requirements shall be resolved as determined by the Engineer.

The materials used in the construction of lighting systems shall meet the requirements of the following subsections of Section 700- Materials and Manufacturing:

Aluminum Light Standards and Arms	723-01
High Mast Pole, Head Frame Assembly with Luminaire Ring and Lowering Device	723-02
Portable Power Drive for High Mast Luminaire Lowering System	723-03
Anchor Base (Aluminum)	723-10
Breakaway Transformer Base (Aluminum)	723-15
Rigid Plastic Conduit	723-19
Metal Steel Conduit, Zinc Coated	723-20
P.V.C. Coated Galvanized Steel Conduit	723-23
Flexible Liquid-Tight Steel Conduit	723-24
High Pressure Sodium Vapor Luminaires (Standard Mount)	723-27
Low Pressure Sodium Vapor Luminaires (Underbridge Mount)	723-28
High Pressure Sodium Vapor Luminaires (Underbridge Mount)	723-29
Mercury Vapor Luminaires (Standard Mount)	723-30
Mercury Vapor Luminaires (Underbridge Mount)	723-31
Cast Iron Junction Box	723-40
Precast Reinforced Concrete Foundations and Pullboxes	723-45
Photoelectric Control	723-50
Anchor Bolts	723-60
Single Conductor Cable	723-70
Single Conductor Direct Burial Cable	723-71
Ground Wire	723-75
Rubber Impregnated Woven Cotton-Polyester Fabric	728-01
Rubber Impregnated Random Fiber Pad	728-02

All cast-in-place concrete base, foundations and pullboxes shall conform to the requirements of Section 501, Portland Cement Concrete - General, except that the requirements for inspection facilities, automated batching control and recordation do not apply. The concrete shall be Class A concrete for structures unless otherwise specified. The batching, mixing and curing methods, and the inspection

facilities shall meet the approval of the Department or its representative. The Contractor may submit for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

For situations which require depositing structural concrete under water, provide Class G concrete as described in Table 501-3 *Concrete Mixtures* and Table 501-3A *Pozzolan Substitutions*. For design and construction purposes, the minimum compressive strength of concrete used in the foundations shall be 3000 psi @ 28 days.

All precast concrete bases and foundations shall meet the requirements of §723-45 Precast Reinforced Concrete Foundations and Pullboxes. Anchor bolts encased in concrete foundations shall meet the requirements of §723-60, and shall be set by template.

All concrete bases, foundations and pullboxes shall conform to the dimensions and details shown on the plans, standard sheets and specifications.

Materials will be subject to inspection at any time during the contract. Failure of the Engineer to note faulty material or faulty installation during construction will not relieve the Contractor of responsibility for removing or replacing such materials or redoing work which may fail to pass any of the Engineer's inspections of this work.

**670-2.01 Conduit.** Couplings, condulets, adaptors and bends shall be made from the same material as the conduit, unless otherwise indicated on the plans or directed by the Engineer.

**670-2.02 Pullboxes.** Pullboxes shall be cast-in-place or precast concrete units. Precast concrete units shown on the contract drawings for rectangular or circular pullboxes will be acceptable if they are of sufficient interior volume required under the pay item. If no drawings are given, the details shown on the Standard Sheet "Pullbox, Conduit and Ground Rod Installation Details" shall apply.

**670-2.03 Luminaires.** Luminaires shall be suitable for severe vibrations up to 3 G's, and lamp supports shall be provided if the lamp is horizontally mounted.

### **670-3 CONSTRUCTION DETAILS**

**670-3.01 Plans.** The Contractor shall study the plans and details and use them as a guide in determining the location of the highway lighting equipment. Any discrepancies in the contract documents shall be resolved with the Engineer before any materials are ordered. Additionally, the manufacturer or supplier of the lighting equipment shall also use the plans to clearly label what each component part is or where it is to be installed.

All installation shall conform to the latest EEI, NEMA, ANSI and ASTM standards. In addition workmanship shall conform to the latest requirements of the Code; the rules of the New York State Public Service Commission; local power company requirements and any local ordinances which may apply.

Any work performed within the boundaries of New York City shall also be in accordance with the latest version of "Division of Street Lighting Specifications". Differences in standards or code requirements shall be resolved as determined by the Engineer.

**670-3.02 Shop Drawings.** The Contractor shall submit five copies of the Manufacturer's Shop Drawings to the Engineer for approval. High Mast Lighting drawings will be approved by DCES. These drawings shall cover the following items and be submitted at least ten working days prior to ordering the light standards, breakaway transformer bases, arms, precast concrete foundations and high mast poles, head assemblies and lowering devices. The shop drawings shall be neatly drawn and clearly legible.

For luminaires and photoelectric controls, catalog cuts may be submitted to the Engineer.

**670-3.03 Excavation and Miscellaneous Work.** All excavation shall be performed in accordance with Section 206 *Trench, Culvert and Structure Excavation*, including the protection of workers and the public. Cuts in roadways, sidewalk surfaces and driveways shall be done in a neat manner, so as to cause the least possible damage. Sawcutting will be required unless otherwise shown on the plans or directed by the Engineer.

Excavation shall not be performed until immediately before installation of the conduit, direct burial cable or any other appurtenances.

The excavated material will be placed in a location or locations approved by the Engineer. These locations shall be selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to cause the minimum interference with the surface drainage.

All surplus excavated material shall be removed and disposed of by the Contractor as specified in Section 203, *Disposal of Surplus Excavated Material*. Excavations shall be backfilled as specified in Section 203, *Select Granular Fill*. After backfilling, the location shall be maintained to the satisfaction of the Engineer until permanent repairs are made.

Pavement or structure courses shall be replaced as specified in §206-3.02, Replacement of Pavement Structure Courses, except that in concrete sidewalks, the complete sidewalk panel shall be removed and replaced.

**670-3.04 Foundations.** Locations of concrete foundations for light standards shown on the plans are approximate only and the exact location will be determined in the field. The Contractor has the option to use precast foundations in place of cast-in-place foundations for light standards. However, precast foundations shall not be allowed for high mast systems.

All excavation necessary for constructing or installing a lamppost foundation shall be performed in conformance to §670-3.03.

When cast-in-place concrete foundations can be constructed in undisturbed soil, as determined by the Engineer, the concrete shall be poured in direct contact with the earth. Holes shall contain no free water, nor any loose material at the time of placement of Class A concrete. If unable to dewater the shaft and place Class A concrete due to the presence of groundwater and loose cohesionless soil at the base of the drilled shaft, proceed with the installation by not dewatering the shaft excavation and place Class G tremie concrete in accordance with §555-3.05 *Depositing Structural Concrete Under Water*. The bottom of the shaft excavation shall be cleaned of loose material to the satisfaction of the Engineer immediately prior to concreting. Forms shall not be used unless the excavation is oversize or where neat limits must be maintained. The top 12 to 20 inches shall be formed as specified on the plans or as directed by the Engineer. Care shall be taken to construct the tops of all foundations so they are level and true to line and grade. Anchor bolts shall be set by template, as ordered by the Engineer.

When cast-in-place concrete foundations are to be constructed in soil that will not support a vertical cut, the foundations shall be formed. When forms are used, the foundations shall be backfilled and compacted allowing sufficient room for the compaction equipment selected. For drilled shaft foundations under no circumstances shall temporary casing be left in place. All temporary casing shall be removed as the concrete is placed. When precast foundations are used, the size of the precast foundation shall not be less than that shown on the plans or standard sheet for cast-in-place foundations. They are only to be used in conjunction with one of the following special excavation and backfill methods to insure foundation stability:

**Method A.** The excavation shall allow a minimum clearance of 6 inches around the precast foundation to be backfilled with concrete meeting the requirements of §501-2.02, Class A. For backfill purposes, small construction mixers will be permitted.

**Method B.** The excavation shall allow a minimum clearance around the precast unit compatible with the compaction equipment used. The clear area shall be backfilled with Select Granular Fill in accordance with §203-2.06 *Select Granular Fill*, and compacted in accordance with §203-3.06 *Select Granular Fill*. Method A or Method B can be used in undisturbed areas. Only Method B is to be used in disturbed areas.

**670-3.05 Grounding.** A 10 foot by 5/8 inch diameter, copperclad ground rod shall be driven near each foundation, maintaining at least 2 inch of cover, or through selected pullboxes where metal conduit is used. The ground rod shall be electrically connected to the base of the pole with a No. 6 soft drawn bare stranded copper ground wire. A copperclad groundwire clamp shall be used to attach the ground wire to the ground rod.

Where a 10 foot ground rod cannot be driven, or is insufficient to provide adequate grounding (see §670-3.16), alternate methods shall be used as shown on the plans or ordered by the Engineer. Such alternate methods can include changing the ground rod length or location, or connecting the ground wire to some other grounded object.

**670-3.06 Light Standards, Breakaway Transformer Bases and Arms.** Each metal light standard shall be set vertically (within 1° of plumb) on a foundation or anchorage, employing approved shims when necessary, either with or without a transformer base as shown on the plans or in the proposal. The transformer base, or the anchor base when a transformer base is not used, shall be securely bolted to the anchorage by the anchor bolts previously set.

The individual light standards shall be identified as required by the responsible maintenance agency and as shown on the plans.

Each arm shall be mounted on the shaft so the luminaire will be at the proper mounting height as shown on the plans. The mounting height shall be measured from the center of the light source to the pavement. The arms shall be in a plane perpendicular to the roadway. The Contractor, in conjunction with the Engineer, shall determine the necessary elevation data for fabricating the light standard with the correct mounting height.

A Number 8 Gauge galvanized steel or 1/4 inch nylon rope drag line shall be furnished and installed running from the terminal strip area in the luminaire to the anchor base or box where the power distribution cable is or will be installed. This drag line shall be securely anchored at each end, and removed only after the cables are installed.

The protective wrapping shall not be removed from any of the shafts or arms until the Engineer instructs the Contractor to do so.

**670-3.07 Conduit.** Underground conduit shall be either zinc coated metal steel conduit, PVC coated galvanized steel, rigid plastic, or flexible liquid-tight steel conduit, as indicated on the plans, and shall be carefully laid in trenches prepared to receive them. Unless indicated otherwise, conduits in exposed areas, when attached to the outside of structures, such as underdeck installations, shall be PVC coated galvanized steel conduit installed as shown on the plans or in a manner approved by the Engineer. Hot dipped, galvanized or non-rusting alloy steel clamps shall be provided to support the conduit at intervals not exceeding 4 feet or as directed by the Engineer.

Underground conduit installations shall have a minimum cover of 18 inches except under roadways, where the minimum cover shall be 24 inches. The conduit shall be laid on a uniform grade to allow any condensation to drain to pull boxes or “T” drains, as detailed on the Standard Sheet “Pullbox, Conduit and Ground Rod Installation Details”. Where uniform grades cannot be maintained, “T” drains shall be installed where directed by the Engineer. Conduit shall be backfilled in accordance with Section 203, *Select Granular Fill*. However, in rock excavations, a bedding of selected backfill must be placed and tamped before laying the conduit.

All bends in the conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed, unless a template is used, for all bends in steel conduit. No bends will be accepted for exposed conduit which shows any evidence of destruction of the protective coating.

Where conduits terminate at pullboxes, the Contractor shall break into the pullbox and seal, usually with mortar, the remainder of the hole(s) in a manner acceptable to the Engineer. Sealed bonding bushings shall be provided at each conduit outlet in boxes. Bushing caps, to prevent entry of dirt and

refuse prior to pulling cables, shall be placed on all conduit ends. Outlet boxes with conduits properly connected shall be accurately located according to the plans and securely fastened.

All conduits installed shall be tested for clear bore and correct installation by the Contractor using a ball mandrel, brush and snake before the installation will be accepted. Two short wire brushes shall be included in the mandrel assembly. Snaking of conduits shall be done by the Contractor in the presence of the Engineer. Any conduit which rejects the mandrel shall be cleared and the Contractor shall bear all costs to replace defective conduit and restore surface to original condition.

Numbers or letters shall be assigned to the various conduit runs, and as they test clear, they shall be identified by a brass tag, no less than 1 1/4 inch in diameter, attached by means of No. 20 AWG brass wire. All conduit terminations in pole bases or pull boxes shall be tagged.

As the conduit runs test clear, a record shall be kept under the heading of "Empty Conduits Tested, Left Clear, Tagged and Capped," showing conduit designation, diameter, location, date tested and by whom. When completed, this record shall be signed by the Electrical Inspector and submitted in triplicate for approval. This record shall be entered on the Record Drawings.

All empty conduit and duct openings after test, shall be capped or plugged by the Contractor as directed. After a conduit is properly installed and cleaned, the Contractor shall furnish and install in each conduit run a No. 10 AWG galvanized steel drag line or nylon or polypropylene rope, with a tensile strength of at least 500 pounds, leaving at least 3 feet of extra line in each pull box, transformer base, or other terminus. If cable is not pulled through the conduit within thirty days, the steel drag shall be grounded to a suitable grounding device at each end of the circuit.

All metallic connections shall be tight to assure continuity of ground bondings.

Conduit shall be placed under existing pavement by approved jacking or boring methods and as directed by the Engineer. The jacking or boring pit shall be located beyond the outside shoulder keeping at least 2 feet clear of the edge of shoulder. Jacking pits will not be permitted in the median, but receiving pits may be dug in grass medians after the jacking is completed if permitted on the plans or by the Engineer.

**670-3.08 Pullboxes.** Cast-in-place or precast concrete pullboxes shall be constructed at the locations and to the dimensions shown in the plans, standard sheets, specifications, or proposal.

Excavations for pullboxes shall be performed in accordance with the requirements of §206-3, Construction Details for Trench, Culvert and Structure Excavation, and included in this item.

Frames and covers shall be furnished and placed on each pullbox. They shall be placed true to line and grade and make full and even bearing on the pullbox.

The frames and covers shall be of the design and detail shown in the plans, standard sheets, specifications or proposal. Frames and covers which do not fit together properly, are warped or rock, will be rejected by the Engineer. Any material rejected by the Engineer, will be removed from the site by the Contractor.

No pullbox shall be backfilled until all cement concrete has sufficiently hardened and forms, if any, have been removed.

The requirements of Section 203, *Select Granular Fill*, shall apply.

**670-3.09 Junction Boxes.** Cast iron junction boxes shall be installed at the locations shown on the plans. For surface mounting, the boxes shall be securely bolted to brackets as detailed on the plans. For installation where boxes are embedded in cement concrete, the boxes shall be set with the covers flush with the surface.

All hardware used in conjunction with mounting of these boxes shall be rust and corrosion resistant.

**670-3.10 Luminaires.** Luminaires of the type and wattage specified, complete with all components shall be installed where shown on the plans standard sheets, or proposal or where directed by the Engineer. All necessary field adjustments required to achieve the specified light distribution shall be performed as directed by the Engineer.

**A. Standard Mounting.** Luminaires shall be installed on light standard mast arms with the vertical axis perpendicular to the roadway and the longitudinal axis parallel to the roadway centerline. The luminaires shall be installed, though not necessarily powered, immediately after the mast arms are connected to the shaft. Otherwise, vibration dampeners shall be used until the luminaires are installed.

**B. Underbridge Mounting.** Luminaires of the type and wattage specified shall be installed on wall mounts or outlet box studs.

Self-contained underbridge luminaires complete with all specified ballasts, and any other appurtenances necessary shall be installed according to manufacturers written instructions, as shown on the plans, as specified in the proposal or as directed by the Engineer.

**670-3.11 Photoelectric Control.** Photoelectric controls shall be installed at the locations shown on the plans, preferably facing north, and properly adjusted to energize the luminaires at the specified illumination levels.

**670-3.12 Single Conductor Cable and Single Conductor Direct Burial Cable.** Wire installation shall not start until raceways and boxes have been cleared of all foreign matter and all other operations of the work which are likely to damage the conductors have been completed. The National Electric Code Rules shall be observed regarding installation of wire and cable.

Unless otherwise specified, splices will be permitted only in pullboxes, junction boxes, utility manholes, luminaires, transformer bases, and lamppost hand holes. All conductor runs between units of equipment shall be without splices. Conductors in control cabinets shall not be spliced.

All splices shall be capable of satisfactory operation under continuous submersion in water. Multiple conductors shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the conductors.

Moisture shall be excluded from the joint during the splicing operation and the work shall be done in dry weather or under shelter. Perspiration from the splicer's hand should be wiped off with dry material. All materials and tools involved in the splicing process shall be kept dry.

One of the following methods shall be used for making a watertight and electrically insulated splice:

**Method No. 1.** The outer covering and insulation shall be removed from each conductor for a minimum length necessary for the use of a pressure release crimping tool. The conductor ends shall be bared and jointed with a seamless, solderless type sleeve connector of the same AWG size as the conductor being spliced, using a pressure release crimping tool designed for the size connector being used. After crimping the sleeve connector shall maintain proper contact with both conductors around the circumferences of the splice and along the length of the sleeve.

The portion of each conductor where insulation has been removed, and the sleeve connector, shall be reinsulated using a coat of fast drying sealing agent of electrical grade, wrapped tightly with overlapping layers of rubber tape, a second coat of the sealing agent applied, and then wrapped tightly with overlapping layers of polyvinylchloride tape.

The sealing agent and tape shall extend at least 1 inch onto the undisturbed insulation of each conductor. Sufficient layers of tape shall be applied to equal 1.5 times the thickness of the original insulation.

Rejacketing the cable shall be accomplished in a similar manner as described above except that the sealing agent and tape shall extend at least 4 inches onto the undisturbed outer covering of each cable.

Individual splices in each conductor shall be staggered to minimize the outside diameter of the splice.



**Method No. 2.** All of the requirements for splicing, specified in Method No. 1, shall apply, except that the completed splice including sleeve connector and the portion of each conductor where the insulation has been removed, shall be reinsulated and the conductor rejacketed by using an acceptable mold poured full with a two component dielectric epoxy resin. The resin shall not require external heating to produce satisfactory pouring consistency.

**670-3.13 Ground Cable.** Ground cable shall be installed where and as detailed on the plans or as directed by the Engineer.

**670-3.14 Regulations.** All work shall be done in accordance with latest edition of the national electrical safety codes, rules and regulations of the State authorities having jurisdiction over such work, and regulations of the utility companies where the work is being installed. Where differences or discrepancies occur, the most stringent requirements shall apply.

**670-3.15 Prosecution of Work.** All work shall be done by qualified and experienced mechanics of each labor class, as determined by the Engineer. All work shall be inspected and approved by the Engineer before concealment.

**670-3.16 Tests.** The Contractor shall conduct all tests, in the presence of the Engineer. The equipment required for each test shall be supplied by the Contractor, along with the equipment manufacturer's written instructions describing how to perform the test. The following tests shall be performed by the Contractor, at the time directed by the Engineer, prior to acceptance of the work:

**A. Insulation Test.** Each circuit with associated ballasts and protective devices shall be insulation tested using an insulation tester connected according to manufacturers instructions. A polarization index shall be computed by dividing a ten minute reading by a one minute reading. The polarization index shall be greater than four (4) for acceptance of new circuits, and greater than two (2) for acceptance of existing circuits. The lighting system shall be properly grounded and disconnected while this test is taking place.

**B. Ground Test.** A ground test shall be performed by the Contractor using an earth tester with resolution to at least a tenth of an ohm. The test shall be performed, and the results interpreted, according to manufacturer's instructions. Readings of five ohms or less will be required for acceptance. Additional grounding methods satisfactory to the Engineer may be necessary until the installation can pass the ground test.

**C. Functional Test.** After satisfactory completion of all other tests, a functional test shall be performed consisting of not less than ten consecutive days of satisfactory operation. If unsatisfactory performance of any component of the lighting system is discovered during this time, the condition shall be corrected and the Engineer may require the test repeated until ten days of continuous satisfactory operation is obtained.

Temporary shut downs caused by power interruption or vehicle impact shall not constitute discontinuity of the functional test.

**670-3.17 Coordination with Utility Company.** The Contractor shall be responsible for all coordination with and between the utility company.

The Contractor shall make all necessary arrangements with the utility company for the required electrical services necessary for the energizing of a temporary lighting installation and barricade lighting.

The Contractor shall comply with the utility company regulations. The utility company will connect and disconnect the power as required. When an entry into a service manhole or attachment to any utility company pole is required, the Contractor shall notify the utility company sufficiently in advance, and

under no condition shall the Contractor enter any utility company owned manhole or place an attachment to a utility company owned pole without an agreement with the utility company.

The service points shown on the plans are approximate only and the Contractor shall determine the exact location from the serving utility company.

When called for in the contract documents the Contractor shall make arrangements with the local utility company to complete the service connections.

**670-3.18 Removal and Disposal, or Storage, of Lighting Equipment.** Existing lighting equipment designated for storage shall be carefully removed from their present locations by disconnecting the conductors, unbolting the mast arm(s) and luminaire(s) and detaching the shaft (and transformer base) from the anchor bolts. The work shall be performed in a manner acceptable to the Engineer. Component parts designated for storage shall be neatly stored and protected during storage at locations and in a manner as approved by the Engineer. Standards designated for removal and disposal shall be disposed of by the contractor in a manner approved by the Engineer within the directed time period after removal from their original location. The concrete lamppost foundations shall be cut free of the attached trenched conduits and shall be removed by the Contractor from the job site. The hole resulting from removing the foundation shall be filled with an approved material and compacted as directed by the Engineer.

**670-3.19 Relocation of Lighting Equipment.** Lighting equipment designated for relocation shall be detached and stored as per §670-3.18, reinstalled and successfully retested at the new location. The complete relocation shall take place in one work shift unless otherwise shown on the plans or ordered by the Engineer.

Where bracket arms and luminaires are to be relocated onto other utility poles, the down leads shall also be relocated, or replaced in kind if necessary, AOB. (Down leads include small sections of conduit or wood molding, wires and fuses connecting the secondary power supply line to the luminaire.) The bracket arm shall be attached to the pole with hardware similar to existing. The Contractor shall also relocate the epoxied strap used where the bracket arm is located above telephone lines.

Any part of the bracket arm, luminaire, or down lead damaged during removal or reinstallation shall be replaced or repaired to the satisfaction of the Engineer.

**670-3.20 High Mast Pole, Head Frame Assembly and Lowering System.** The high mast steel pole, head frame assembly and lowering system shall be installed in accordance with the manufacturer's recommendations, or as directed by the Engineer. With each installation a Manufacturer's instructional manual shall be furnished in each pole base. This manual shall include, but not be limited to the following details:

1. Raise and lower assembly instructions
2. Operating instructions
3. Maintenance instructions
4. Attachments

Additionally, the luminaire ring with all luminaires installed shall be lowered and raised five (5) times, at least twice in the coldest part of the winter and twice in the hottest part of the summer, if possible, to test functionality. These test dates shall be determined by the Engineer. Failure to lower or rise properly will be means for rejection of the assembly.

**670-3.21 Portable Power Drive for High Mast Luminaire Lowering System.** The portable power drive shall be used to raise and lower the luminaire ring as described above, and be delivered in good condition to the location shown on the plans upon acceptance of the high mast system.

#### **670-4 METHOD OF MEASUREMENT**

**670-4.01 Foundations.** Lighting standard foundations will be measured as the number of complete units installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.02 Light Standards.** Light standards will be measured as each standard of the type specified, complete, in place, in accordance with plans, specifications or as directed by the Engineer.

**670-4.03 Arms.** Arms of the type and length specified will be measured by the number of units furnished and installed on the respective light standards (or wood poles) according to the plans, specifications or as directed by the Engineer.

**670-4.04 Breakaway Transformer Base.** Breakaway transformer bases will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.05 Conduit.** Conduit will be measured by the linear foot along the axis of the conduit, of the type and size specified, installed according to the plans, proposal, or as directed by the Engineer. Measurement shall include all couplings, condulets, adaptors and bends.

**670-4.06 Pullboxes.** Pullboxes, including frames and covers, will be measured as the number furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.07 Junction Box.** Cast iron junction boxes will be measured as the number of each size furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.08 Luminaires.** Luminaires of the type and wattage specified will be measured by the number of units furnished and installed according to the plans, specifications or as directed by the Engineer.

**670-4.09 Photoelectric Controls.** Photoelectric controls will be measured as each control furnished and installed in accordance with the plans, specifications or as directed by the Engineer.

**670-4.10 Single Conductor Cable and Direct Burial Cable.** Single Conductor Cable wire will be measured for payment by the number of linear feet of single conductor of each size actually installed in accordance with the plans and specifications or as directed by the Engineer.

**670-4.11 Ground Wire.** Ground wire will be measured for payment by the number of linear foot of ground wire installed in accordance with the plans and specifications or as directed by the Engineer.

**670-4.12 Removal of Lighting Equipment.** The removal of lighting equipment will be measured by the number of light standards (including bracket arms and luminaires), or foundations, removed from the site and stored or disposed of as ordered by the Engineer.

**670-4.13 Relocation of Lighting Equipment.** The relocation of lighting equipment will be measured by the number of specified units removed and reinstalled at the new location.

**670-4.14 High Mast Pole, Head Frame and Lowering Assembly.** High mast steel pole, head frame assembly and lowering system will be measured by the number of complete units furnished and installed in accordance with the contract documents.

**670-4.15 Portable Power Drive for High Mast Luminaire Lowering System.** The portable power drive for high mast luminaire lowering system will be measured by the number of complete units delivered.

## **670-5 BASIS OF PAYMENT**

**670-5.01 General.** The Contractor shall pay all fees and expenses for testing, service connections, licenses, electrical energy and any other cost he may incur in constructing the highway illumination system, except that the cost of electrical energy used for public benefit prior to the completion of the contract will be borne by the State, when such operation is directed by the Engineer in writing. The cost of all minor miscellaneous components shall be included in the price bid for the various lighting items.

**670-5.02 Foundations.** The unit price for each lighting standard foundation shall include the cost of all labor and materials necessary to complete the work, including conduit elbows, grounding system, anchor bolts, all appurtenances, excavation, special fill, and any protective system(s) required to ensure the safety of the workers and the public.

**670-5.03 Light Standards.** The unit bid for each light standard shall include the cost of all labor and other materials necessary to complete the work.

**670-5.04 Arms.** The unit price bid for each arm of the type and length specified shall include the cost of the arm, appropriate down leads and all labor and other materials necessary to install it on the designated light standard or wood pole shown on the plans.

**670-5.05 Breakaway Transformer Bases.** The unit price bid for each breakaway transformer base shall include the cost of the breakaway transformer base and all labor and other materials necessary to install it where shown on the plans.

**670-5.06 Conduit.** The unit price bid per linear foot shall include the conduit and all labor and other materials necessary to complete the work, including couplings, condulets, adaptors or bends. Excavation and backfill for conduit shall be paid for separately under the item for Conduit Excavation and Backfill or as indicated.

**670-5.07 Pullbox.** The unit price bid for each pullbox shall include the cost of all excavation, backfill, frames, covers, labor, equipment, and other materials necessary to complete the work.

**670-5.08 Junction Box.** The unit price bid per each junction box shall include the cost of furnishing and installing cast iron junction boxes, and all labor, equipment and any other material necessary to complete the work.

### **670-5.09 Luminaires**

**A. Standard Mount.** The unit price bid for each standard mount luminaire shall include the cost of the luminaire of the type specified, labor and other material necessary to complete the work.

**B. Underbridge Mount.** The unit price bid for each underbridge luminaire shall include the cost of the underbridge luminaire of the type specified, complete with mounting hardware, and all labor and other materials necessary to complete the work.

**670-5.10 Photoelectric Controls.** The unit price bid for each control shall include the cost of all labor, equipment and any materials necessary to complete the work.

**670-5.11 Single Conductor Cable and Direct Burial Cable.** The unit price bid per linear foot shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work.

Cable from the pole base to the luminaire, or from the overhead power source to the luminaire, will be included in the light standard item or bracket arm item.

**670-5.12 Ground Wire.** The unit price bid per linear foot shall include the cost of furnishing all labor, materials, and equipment to satisfactorily complete the work.

**670-5.13 Remove and Store Lighting Equipment.** The unit price bid for removing and storing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

**670-5.14 Remove and Dispose of Lighting Equipment.** The unit price bid for removing and disposing lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Removing concrete foundations will be paid for under its appropriate item.

**670-5.15 Relocate Lighting Equipment.** The unit price bid for relocating the lighting equipment shall include the cost of all labor, materials and equipment necessary to complete the work. Installing new concrete foundations will be paid for under their appropriate items. New conductors and conduit, where necessary, will also be paid for separately.

**670-5.16 High Mast Pole, Head Frame Assembly, and Lowering System.** The price bid shall include the furnishing of all labor, materials, and equipment necessary to complete the work. The luminaires will be paid for separately.

**670-5.17 Portable Power Drive for High Mast Luminaire Lowering System.** The price bid shall include the entire power drive assembly, and winch if necessary, delivered to the location indicated on the plans or directed by the Engineer.

***Payment will be made under:***

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
670.01XX	Foundation for Light Standards <i>XX = Foundation Length in whole feet.</i>	Each
670.11XX	Aluminum Light Standards for Single Member or Truss Arm(s) <i>XX = Mounting Height in feet (26, 30, 36, 40, 43, 46, 53)</i>	Each
670.12XX	Aluminum Single Member Bracket Arm <i>XX = Arm Length in feet (4, 6, 8, 10)</i>	Each
670.13XX	Aluminum Trussed Arm <i>XX = Arm Length in feet (10, 12, 15, 18, 20)</i>	Each
670.14XX	Aluminum Bracket Arm, Wood Pole Mounted <i>XX = Arm Length in feet (6, 8, 12, 15, 18)</i>	Each
670.15XX	Aluminum Light Standard for Single Davit Arm <i>XX = Mounting height in feet (30, 36, 40, 43, 46, 53)</i>	Each
670.16XX	Aluminum Light Standard for Double Davit Arms <i>XX = Mounting height in feet (30, 36, 43, 46, 53)</i>	Each
670.17XX	Aluminum Davit Arm <i>XX = Arm Length in feet (6, 12, 15, 18, 20)</i>	Each
670.0XXXZZ	High Mast Pole, Head Frame Assembly with Luminaire Ring and Lowering Device <i>XXX = Height of pole in feet (100, 120, 150)</i> <i>ZZ = Number of luminaire tenons (03, 04, 05, 06, 08, 10, 12)</i>	Each
670.010001	Portable Power Drive for High Mast Luminaire Lowering System	Each
670.19	Breakaway Transformer Base (Aluminum)	Each

670.20XX	Galvanized Steel Conduit	Foot
XX=	01 02 03 04 05 06 07 08	
INCHES=	3/4 1 2 3 4 5 1 1/2 1 1/4	
670.23XX	Galvanized Steel Plastic Coated Conduit	Foot
XX=	01 02 03 04 05 06 07 08 09 10 11 12	
INCHES=	1/2 3/4 1 1 1/4 1 1/2 2 2 1/2 3 3 1/2 4 5 6	
670.25XX	Flexible Conduit	Foot
XX=	01 02 03 04 05 06 07	
INCHES=	3/4 1 1 1/4 1 1/2 2 3 4	
670.26XX	Rigid Plastic Conduit	Foot
XX=	01 02 03 04 05 06	
INCHES=	1 2 3 4 5 6	
670.3001	Pullboxes less than 5 cubic feet, inside volume (Lighting)	Each
670.3006	Pullboxes 5 to 7 1/2 cubic feet, inside volume (Lighting)	Each
670.3010	Pullboxes over 7 1/2 to 10 cubic feet, inside volume (Lighting)	Each
670.3020	Pullboxes over 10 to 15 cubic feet, inside volume (Lighting)	Each
670.3030	Pullboxes over 15 cubic feet , inside volume (Lighting)	Each
670.40	Cast Iron Junction Boxes	Each
670.50TCWW	Luminaire	Each
<i>T= Type of Lamp and Mounting:</i>		
<i>1=High Pressure Sodium Vapor, Std. Mount; 2=High Pressure Sodium Vapor, Underbridge Mt.;</i>		
<i>3=Low Pressure Sodium Vapor, Underbridge Mt.; 4=Mercury Vapor, Std Mount;</i>		
<i>5=Mercury Vapor, Underbridge Mount</i>		
<i>C= Cutoff Characteristics</i>		
<i>1=Short, Cutoff; 2=Medium, Semi-cutoff; 3=Long, Non-cutoff;</i>		
<i>4=Medium, Cutoff; 5= Long, Semi-cutoff; 6=Medium, Non-cutoff; 7=Short, Non-cutoff</i>		
<i>8=Short, Full Cutoff; 9=Medium, Full Cutoff</i>		
<i>WW= Wattages</i>		
<i>03=35 watts; 05=50 watts; 07=70 watts; 15=150 watts;</i>		
<i>20=200 watts 25=250 watts; 40=400 watts; 01=1000 watts;</i>		
<i>55=55 watts; 09=90 watts; 10=100 watts; 13=135 watts; 17=175 watts; 70=700 watts</i>		
670.60	Photoelectric Controls	Each
670.70XX	Single Conductor Cable	Foot
XX =	02 03 04 05 06 07 10 20 30 40	
Gage =	2 4 6 8 10 12 1/0 2/0 3/0 4/0	
670.71XX	Single Conductor Direct Burial Cable	Foot
XX =	01 02 03 04 05 06 07	
Gage =	4/0 2/0 1/0 2 6 10 12	
670.7501	Ground Wire No. 6 AWG.	Foot
670.80	Remove and Store Lamppost Assembly	Each
670.81	Remove and Dispose of Lamppost Assembly	Each
670.82	Remove Lamppost Foundation	Each
670.90	Relocate Lamppost Assembly	Each
670.91	Relocate Bracket Arm With Luminaire	Each

**SECTIONS 671 THRU 674 (VACANT)**

## **SECTION 675 - RAILROAD TRACK AND APPURTENANCES**

**675-1 DESCRIPTION.** The work in this section shall include work required for railroad track and appurtenances.

**675-2 MATERIALS.** Materials shall be as specified in the special specifications.

**675-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**675-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**675-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTIONS 676 THRU 679 (VACANT)**

## **SECTION 680 - TRAFFIC SIGNALS**

(Last Revised September 1, 2021)

### **680-1 DESCRIPTION**

**680-1.01 Work.** This work shall consist of furnishing and installing new traffic signal equipment, in accordance with the plans, specifications, standard sheets, or directions of the Engineer.

**680-1.02 Definitions.** The following definitions shall apply to all work, equipment, and materials included under this section:

1. Actuation - The operation of any type of detector.
2. Controller - That part of a controller assembly which performs the basic timing and logic functions.
3. Controller Assembly - The complete assembly for controlling the operation of a traffic signal, consisting of a controller together with all auxiliary equipment, housed in a weatherproof cabinet or cabinets.
4. Cycle Length - The time in seconds required for one complete signal cycle.
5. Detector - A device for indicating the passage or presence of vehicles or pedestrians.
6. Inductance Loop Detector - A detector consisting of a wire loop embedded in the roadway surface connected to an electronic device that is capable of sensing the passage or presence of either moving or stationary vehicles by a change in the electrical inductance characteristics of the wire loop.
7. Interval - That part or parts of a signal cycle during which signal indications do not change.
8. Phase - That part of a signal cycle allocated to any traffic movement receiving the right of way or to any combination of traffic movement receiving the right of way simultaneously during one or more intervals. Each phase shall consist of at least one green interval and one yellow clearance interval.
9. Signal Cycle - A complete sequence of signal indications.
10. Signal Face - That part of a signal head provided for controlling traffic in a single direction and consisting of one or more signal sections. Turning indications may be included in a signal face.
11. Signal Head - An assembly containing one or more signal faces which may be designated accordingly as one-way, two-way, etc.
12. Signal Indication - The illumination of a traffic signal lens or equivalent device, or a combination of several lenses or equivalent devices at the same time.

13. Signal Section - A complete unit for illuminating a lens consisting of a housing, lens, reflector, lamp receptacle, and lamp.
14. Type I Traffic Signal Section. A Type I Traffic Signal Section is a standard or polycarbonate traffic signal section without reflector, reflector ring, lens, and lamp receptacle.
15. Type I Pedestrian Signal Section. A Type I Pedestrian Signal Section is a standard or polycarbonate pedestrian signal section without reflector, lens, and lamp receptacle.

## 680-2 MATERIALS

**680-2.01 Traffic Signal Equipment.** The specific components used in the construction of new traffic signal systems shall meet the requirements of the following subsections included under Section 700-Materials and Manufacturing:

Bar Reinforcement, Grade 60	709-01
Iron Castings	715-05
Breakaway Transformer Base	723-15
Rigid Plastic Conduit	723-19
Metal Steel Conduit, Zinc Coated	723-20
P.V.C. Coated Galvanized Steel Conduit	723-23
Flexible Liquid-Tight Steel Conduit	723-24
Cast Iron Junction Boxes	723-40
Precast Reinforced Concrete Pullboxes	723-45
Signal Cable	724-01
Span Wire	724-02
Traffic Signal Poles	724-03
Traffic Signal Heads	724-04
Shielded Communication Cable	724-08
Signal Cable with Integral Messenger	724-09
Shielded Communication Cable with Integral Messenger	724-10
Traffic Signal Pole Mounting Hardware	724-11
Fire Pre-emption Tell Tale Light	724-15
Inductance Loop Wire	724-20
Shielded Lead-in Cable	724-21
Roadway Loop Embedding Sealer	724-22
Pedestrian Push Button and Sign	724-23
Fiberoptic Pedestrian Signal Heads	724-04
Fiberoptic Dual Indication Arrow	724-04
Strobing Signal Indication	724-04
LED Traffic Signal Modules	724-04
LED Pedestrian Signal Modules	724-04

**680-2.02 Concrete.** All cast-in-place pullboxes, signal pole foundations and controller cabinet bases shall meet the requirements of Class A concrete in section 501, Portland Cement Concrete General, except that the requirements for inspection facilities, automated batching controls and recordation do not apply. The batching, mixing and curing methods and the inspection facilities shall meet the approval of the Department or its representative. The Contractor may submit, for approval by Director, Materials Bureau, a mix at least equivalent to the specified Class A Concrete.

For situations which require depositing structural concrete under water, provide Class G concrete as described in Table 501-3 *Concrete Mixtures* and Table 501-3A *Pozzolan Substitutions*. For design and construction purposes, the minimum compressive strength of concrete used in the foundations shall be 3000 psi @ 28 days.



All precast concrete pullboxes, signal pole foundations and controller cabinet bases shall meet the requirements of §723-45 Precast Reinforced Concrete Pullboxes.

**680-2.03 Messenger Wire.** Messenger wire shall meet the requirements of §724-02 Span Wire.

**680-2.04 Guy Wire.** Guy wire shall meet the requirements of §724-02 Span Wire.

**680-2.05 Pullbox Frames and Covers.** Frames and covers shall meet the requirements of §715-05 Iron Castings.

### **680-3 CONSTRUCTION DETAILS**

**680-3.01 Equipment List and Drawings.** Unless otherwise waived, the Contractor shall submit to the Regional Director within 30 days following the award of contract, detailed specifications, catalog cuts, parts list, instruction sheets, and shop drawings of equipment and materials which he proposes to install.

#### **680-3.02 (Vacant)**

**680-3.03 Negotiations with Utility Company.** The Contractor shall be responsible for all negotiations involving utility companies.

The Contractor shall comply with utility company regulations.

When a entry into a service manhole or attachment to any utility company pole is required, the Contractor shall notify the utility company sufficiently in advance. Entry into a service manhole or attachment to any pole shall not be made without the presence of a utility company representative if the utility company so requires. The service points shown on the plans are approximate only and the Contractor shall determine the exact location from the serving utility company.

The Contractor shall make arrangements with the local utility company to complete the service connection.

**680-3.04 Underground Facilities.** The Contractor shall locate all existing underground facilities in accordance with the provisions of Industrial Code Rule 753. It shall be the Contractors responsibility to satisfy himself as to existing conditions and to protect and support in a suitable manner all underground facilities encountered during the trenching and excavating operations. The Contractor shall repair any damage to these lines caused by his operations, and if the nature of the damage is such as to endanger the operations of these services and utilities and the necessary repairs are not immediately made by the Contractor, the work may be performed by the State or other Contractor and the cost thereof charged against the Contractor.

**680-3.05 Test Holes.** Prior to excavating for pole placement and after locating all existing underground facilities, the Contractor shall dig a test hole or holes at the proposed location of each pole. If obstructions are encountered the Contractor shall properly backfill the test hole and move to a new location as directed by the Engineer.

**680-3.06 Work Sites.** The Contractor shall perform all work within the work site in a workmanlike manner and in accordance with U.S. Department of Labor's Occupational Safety and Health Standards.

The sites of the work and adjacent premises shall be kept as free from material, debris and rubbish as is practicable. All such material or debris that accumulates during the work shall be removed by the Contractor as the work progresses.

Neither the materials excavated, nor the materials used, shall be placed so as to prevent access to any fire hydrants, water valves, manholes, police call boxes or fire alarm boxes.

**680-3.07 Schedule of Work.** The Contractor shall notify the local power company at least 72 hours (or as required by the company) in advance of the time that the individual installation is complete and ready for operation in order that taps may be made by the power company to distribution lines.

Upon completion of a signal installation the signal may be placed in service prior to the completion of other installations or the signal head may be covered. The Contractor shall place the signal in operation or cover the head as directed by the Engineer.

When the traffic signal is placed in operation, it shall be operated in accordance with timing schedules to be supplied by the Department.

**680-3.08 Contractor Responsibility with Utilities.** All attachments to utility company poles shall be made in accordance with the specifications and subject to the inspection of the utility companies owning the poles. The height of all proposed attachments above the ground and their locations on the poles shall be in accordance with the plans, standard sheets or as directed by the Engineer and shall meet the approval of the utility companies owning the poles.

The Contractor shall protect all property and materials of the utility companies and shall be responsible for the repair or replacement of any damaged material or property. In the event that the point of attachment or location of the risers is such that the risers interfere with or do not provide proper clearance with existing utility company attachments, the Engineer, in consultation with the utility companies owning the poles, shall make the necessary adjustments in heights and location to eliminate such interference.

**680-3.09 Excavation.** All excavation shall be performed in accordance with Section 206 Trench, Culvert and Structure Excavation, including the protection of workers and the public.

Excavation shall not be performed until immediately before installation of the conduit, direct burial cable, footings, pullboxes or any other appurtenances. The excavated material shall be placed in a location or locations approved by the Engineer. These locations shall be selected by the Contractor so as to cause the least inconvenience to vehicular and pedestrian traffic and to cause the minimum interference with the surface drainage. All surplus excavated material shall be removed and disposed of by the Contractor as specified in Section 203, *Disposal of Surplus Excavated Material*.

Excavation shall be backfilled as specified in Section 203, *Select Granular Fill* After backfilling, the excavation shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

The outline of all areas to be removed in sidewalks, driveways, and pavement shall be saw cut to a depth of at least 3 inches prior to removing the sidewalk, driveway or pavement. Cuts shall be neat and true along score lines with no shatter outside the removal area. Damaged saw cut areas shall be recut.

Pavement, shoulder, sidewalks, curbs, driveways, lawns, plants and other such features shall be replaced in kind with material of equal quality or as shown on the plans, standard sheets or as directed by the Engineer.

Whenever a part of a square or slab of existing concrete sidewalk, curb, gutter or driveway is broken or damaged, the entire square, section or slab shall be removed and replaced with the same kind and quality of material.

For transverse sidewalk, curb or gutter cuts in concrete the entire square or section shall be removed and replaced with the same kind and quality of material. For longitudinal cuts in concrete sidewalks only the area removed between sawcuts shall be replaced unless specified otherwise on the plans.

**680-3.10 Pole Excavation and Concrete Foundation.** Foundations shall be constructed as shown in the contract documents or as directed by the Engineer. However, the Contractor has the option to use either Cast-in-Place or Precast Concrete foundations for the signal poles.

If the Contractor elects to install a cast-in-place foundation, the signal pole may be installed on the foundation three (3) days after concrete placement. However, the span wire and signal heads may not be

installed until the concrete cylinder strength reaches at least 2200 psi. Therefore, the Contractor shall assist the Engineer in making a sufficient number of test cylinders of the foundation concrete, store these cylinders at the location directed by the Engineer, and transport these cylinders to the State testing facility in order to install the traffic signal as soon as possible.

For drilled shaft foundations under no circumstances shall temporary casing be left in place. All temporary casing shall be removed as the concrete is placed.

Holes shall contain no free water, nor any loose material at the time of placement of Class A concrete. If unable to dewater the shaft and place Class A concrete due to the presence of groundwater and loose cohesionless soil at the base of the drilled shaft, proceed with the installation by not dewatering the shaft excavation and place Class G tremie concrete in accordance with §555-3.05 *Depositing Structural Concrete Under Water*. The bottom of the shaft excavation shall be cleaned of loose material to the satisfaction of the Engineer immediately prior to concreting.

If the Engineer requests the submittal of design computations for one or more signal poles, the Contractor shall not start construction of the foundations for those signal poles until the Engineer's review of the submittal is completed. The Engineer will have twenty (20) working days to review the design computation for one signal pole, and an additional two (2) working days for each additional signal pole.

For those poles on which a traffic signal cabinet will be mounted, the Contractor shall orient the pole foundation to align the signal cabinet and cabinet wiring access hole as specified on the plans. If no orientation is specified on the plans, the Contractor shall orient the signal cabinet and cabinet wiring access hole 180° from the span wire or load attachment to the pole, unless otherwise directed by the Engineer. The Contractor shall notify the Engineer three (3) working days in advance of doing any pole foundation work and provide the intended pole orientation.

**680-3.11 Poles.** Poles shall be erected as specified on the plans, standard sheets and as directed by the Engineer.

Pole and signal locations shown on the contract plans shall be field checked for any condition that may affect their placement, where changes are necessary the exact location will be determined by the Engineer.

When field conditions require a change in pole position from that shown in the contract plans, the pole length requirements may vary. It shall be the Contractor's responsibility to verify pole length before ordering poles.

Pole erection shall include installation of mast arms and lighting arms and attachment of fittings as specified on the plans and standard sheets as follows:

1. Anchor bolt covers if specified.
2. Weatherheads and couplings as required.
3. Service bracket.
4. Pole cap and mast arm end caps.
5. Cabinet mounting fittings, plates, brackets as needed for the cabinet being installed.
6. Reinforced couplings for wire entrances to cabinets.
7. Galvanized eyebolt, nuts and washers for attaching span wire assembly.
8. Galvanized pole clamps with eyes for attaching tether wires.

In addition, the Engineer may require the contractor to submit, at any time, design computations for any or all of the traffic signal poles in the contract. The design computations must be approved, stamped and signed by a professional engineer licensed in New York State. The Engineer shall have twenty (20) working days to review the design computations for one traffic signal pole, and an additional two (2) days for each additional signal pole.

If the Engineer's review of a pole's design indicates a problem(s) exists, the Contractor will be notified within the time allotted for the review. In these cases a meeting will be held between the Engineer and the Contractor to resolve the Engineer's concerns.

**680-3.12 Grounding.** A copper clad ground rod, ground wire and fittings shall be installed as shown on the plans, standard sheets or as directed by the Engineer. The ground system shall be electrically connected to the grounding terminal on the pole or controller cabinet.

The ground system when completed shall be tested in accordance with §680-3.32. If the requirements of this test are not met, additional ground rods, ground rod extensions, electrical bonding of metallic conduit or other grounding measures may be required as directed by the Engineer.

**680-3.13 Conduit and Direct Burial Cable.** Conduit and direct burial cable shall be installed as specified on the plans, standard sheets or as directed by the Engineer. Underground conduit and direct burial cable installations shall have a minimum cover of 18 inches except under roadways, where the minimum cover shall be 24 inches unless specified otherwise on the plans, or standard sheets. The conduit shall be laid on a uniform grade to allow any condensation to drain to pull boxes or "T" drains. Conduit shall be backfilled in accordance with Section 203, *Select Granular Fill* In rock excavations a bedding of select backfill must be placed and tamped before laying the conduit.

Conduit may be placed under pavement by jacking or boring methods approved by the Engineer. Pavement may not be disturbed without permission of the Engineer. In the event obstructions are encountered, small test holes may be cut in the pavement upon approval of the Engineer. Jacking or boring pits shall be kept 2 feet clear of the edge of pavement and shoulder whenever possible. Excavation for jacking or boring pits shall be in accordance with §680-3.09 Excavation.

Conduit or direct burial cable may be placed by machine methods approved by the Engineer.

All bends in conduit shall be made without kinking, flattening or appreciably reducing the internal diameter of the conduit. A hydraulic or power pipe bender shall be employed for all bends in steel conduit. Any evidence of destruction of the protective coating will be cause for rejection. All connections in metallic conduit shall be tight. Ends of conduit shall be reamed to remove burrs and rough edges.

Conduit ends in pullboxes, junction boxes, cabinet, etc. shall be equipped with insulating bushings.

All conduits installed shall be tested for clear bore and correct installation by the Contractor in the presence of the Engineer.

All empty conduit after testing shall be immediately sealed by the Contractor.

After a conduit is properly installed, the Contractor shall furnish and install in each conduit run a No. 10AWG galvanized steel drag wire or nylon or polypropylene rope with a tensile strength of at least 500 lb. At least 3 feet of extra wire or rope shall be left at each end.

**680-3.14 Pullboxes.** Pullboxes shall be constructed and installed in accordance with the details specified on the standard sheets or as directed by the Engineer.

Cast iron frames and covers shall be furnished and placed on each pullbox. They shall be set in mortar and placed true to line and grade and make full and even bearing on the underlying construction surface. The frame and cover shall be as shown on the standard sheet. Frames and covers which do not fit together properly, will be rejected by the Engineer and shall be removed from the site.

**680-3.15 Signal Control Cable and Shielded Communication Cable.** Cable shall be installed to form a continuous circuit between the proper equipment terminals. All terminal connections shall be made with approved solderless lugs of the proper size using a crimping tool that is self-releasing when proper compression has been applied. Only connectors that provide continuity and physical contact around the circumference of the connector and conductor shall be used.

During installation of the cable, the Contractor shall take care not to damage conductors, insulation, or outer covering. The length of cable installed shall not cause excessive stress on the conductors or any part of the cable.

An insert lubricant approved by the Engineer shall be used in placing cable in conduit. Cable shall be pulled into conduit by hand and the use of winches or other power actuated pulling equipment will not be permitted.

At least 3 feet but not more than 5 feet of slack shall be left for each cable at each pullbox or junction box. Short bends of cable shall be avoided inside pullboxes. Cable in pullboxes or junction boxes shall not cross over any other cables already in place nor block any conduit. All cable shall be identified as to function in each pullbox, junction box or cabinet by the use of aluminum or brass cable markers. If a wire numbering system is used for identification, the key to the system shall be placed along with the wiring diagram in the controller cabinet.

Conductors in controller cabinets shall be dressed neatly with tie wraps. Spare conductors shall be taped and coiled neatly in the bottom of the cabinet. Ends of spare conductors shall be taped. Field wiring entering controller cabinets shall be identified as to function.

Splices in shielded communication cable will not be allowed between equipment terminals. Where cable is installed on span wire, or messengers, it shall be supported at intervals not greater than 15 inches by messenger rings, stainless steel cable straps or other non-corrosive metal lashing approved by the Engineer. Taping and plastic cable ties will not be permitted.

Integral messenger cable shall be installed in accordance with the details specified on the standard sheets or as directed by the Engineer.

When integral messenger cable is installed on utility company poles, the Contractor shall make all arrangements with the utility company for the installation. The Contractor shall observe all utility company requirements for attachments to poles and clearances with utility wires. The Contractor shall notify the utility company prior to start of the work and observe the utility company requirements for accomplishment of the work.

All necessary hardware used with integral messenger cable shall develop the full breaking strength of the integral messenger wire. Poles at each end and at each change of direction shall be guyed as specified on the plans or directed by the Engineer. When installed on utility company poles, guys shall be installed as directed by the utility company.

**680-3.16 Cable Splices.** Unless otherwise specified, cable splices will be permitted only in pullboxes, junction boxes, utility manholes, and at traffic signal heads. All cable runs between units of equipment shall be without splices unless shown on the plans or authorized by the Engineer. Conductors in controller cabinets shall not be spliced. Splices in overhead cable, when necessary, shall be made with the approval of, and as specified by the Engineer.

All splices shall be capable of satisfactory operation under continuous submersion in water. Multi-conductor cables shall be spliced and insulated to provide a watertight joint and to prevent absorption of moisture by the cable.

Moisture shall be excluded from the joint during the splicing operation and the work shall be done in dry weather or under shelter. Perspiration from the splicer's hand should be wiped off with dry material. All materials and tools involved in the splicing process shall be kept dry.

One of the following methods shall be used for making a watertight and electrically insulated splice:

**Method No. 1.** The outer covering and insulation shall be removed from each conductor for a minimum length necessary for the use of a pressure release crimping tool. The conductor ends shall be bared and joined with a seamless, solderless type sleeve connector of the same AWG size as the conductor being spliced, using a pressure release crimping tool designed for the size connector being used. After crimping the sleeve connector shall maintain proper contact with both conductors around the circumference of the splice and along the length of the sleeve.

The portion of each conductor where insulation has been removed, and the sleeve connector, shall be reinsulated using a coat of fast drying sealing agent of electrical grade, wrapped tightly with overlapping layers of rubber tape, a second coat of the sealing agent applied, and then wrapped tightly with overlapping layers of polyvinylchloride tape.

The sealing agent and tape shall extend at least 1 inch onto the undisturbed insulation of each conductor. Sufficient layers of tape shall be applied to equal 1.5 times the thickness of the original insulation.

Rejacketing the cable shall be accomplished in a similar manner as described above except that the sealing agent and tape shall extend at least 4 inches onto the undisturbed outer covering of each cable.

Individual splices in each conductor shall be staggered to minimize the outside diameter of the spliced cable.

**Method No. 2.** All of the requirements for splicing, specified in Method No. 1, shall apply, except that the completed splice including sleeve connector and the portion of each conductor where the insulation has been removed, shall be reinsulated and the cable rejacketed by using an acceptable mold poured full with a two component electrical insulating resin approved by the Engineer. The resin shall not require external heating to produce satisfactory pouring consistency.

**680-3.17 Span Wire Assembly.** Span wire assemblies including necessary hardware shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer.

Span wire assemblies shall be either single span wire, dual span wire with upper tether or dual span wire with lower tether as specified on the plans.

The Contractor shall determine the span and tether wire diameter based upon pole design load using the table on the standard sheets. All necessary hardware for attaching span and tether wires to the poles shall develop the full breaking strength of the span or tether wire with which it is used, except that breakaway links for lower tether wires shall develop the strength specified on the standard sheets.

Sag shall be adjusted so that it is a minimum of 5 percent of the span when the traffic signal system, including overhead signs, is complete.

The Contractor shall determine the length of suspension and tether wire required to span the distance between poles, allow sufficient length for fastening and sag and after adjustments, make the whole assembly consistent with the plans, standard sheets or as directed by the Engineer.

**680-3.18 Messenger Assembly.** The messenger shall be installed in accordance with the details on the standard sheets or as directed by the Engineer.

When a messenger is installed on utility company poles the Contractor shall make all arrangements with the utility company for the installation. The Contractor shall observe all utility company requirements for attachments to poles and clearance with utility wires. The Contractor shall notify the utility company prior to the start of the work and observe the utility company requirements for accomplishment of the work.

All necessary hardware used with the messenger assembly shall develop the full breaking strength of the messenger strand. Poles at each end and at each change of direction along the run of messenger shall be guyed as specified on the plans or directed by the Engineer. When installed on utility company poles, guys shall be installed where required by the utility company. The signal control cable shall be fastened to the messenger at intervals not greater than 16 inches by messenger rings, stainless steel cable straps or other non-corrosive metal lashings approved by the Engineer. Taping and plastic cable bands will not be permitted.

**680-3.19 Guy Assembly.** Guys shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer. Guys on utility company poles shall meet the utility company requirements.

Excavation for the anchor shall be of the minimum width possible to accept the unexpanded anchor. All backfill shall be compacted.

**680-3.20 Riser Assembly.** Risers and weatherheads shall be installed and constructed in accordance with the details on the standard sheets or as directed by the Engineer. Risers on utility company poles shall meet the utility company requirements.

**680-3.21 Signal Heads.** Signal heads shall be installed as specified on the plans, standard sheets or as directed by the Engineer. Each signal head shall be assembled from signal sections and brackets in the configuration specified on the plans. Signal heads shall be properly aligned to the satisfaction of the Engineer. All mounting hardware shall be securely tightened to prevent loosening by the wind.

Until signal heads are placed in operation they shall be bagged with opaque or other material, as approved by the Engineer, that is adequately secured in a neat and orderly manner.

Optically programmed signal heads shall be installed, directed and veiled in accordance with the manufacturer's instructions, plans, standard sheets and the Engineer's visibility requirements. Each section of the signal shall be masked with prescribed materials in an acceptable and skillful manner.

LED Traffic or Pedestrian Signal Modules, which are supplied by the State, shall be installed in new or existing traffic or pedestrian signal heads as shown on the plans or as ordered by the Engineer. When the Contractor is required to furnish the LED module, unless otherwise waived, the Contractor shall submit to the Regional Director within 30 days following the award of contract, detailed specifications and catalog cuts of the equipment he/she proposes to install. In either case, the Contractor shall first remove any existing components necessary to install the LED modules, and the removed components shall remain the property of the State.

**680-3.22 Wiring Color Code.** The following wire color code system, unless otherwise shown on the plans, shall be used for wiring signal heads:

*A. Through C. (Vacant)*

*D. 1 Through 8 Phases*

1. Priority of assigning signal phases, overlaps and double clearances to Groupings of Color - Coded Wire for Signal Heads:

PRIORITY	FUNCTION		PRIORITY	FUNCTION
1	Phase 5		8	Phase 4
2	Phase 1		9	Overlap No. 1
3	Phase 6		10	Overlap No. 2
4	Phase 2		11	Overlap No. 3
5	Phase 7		12	Overlap No. 4
6	Phase 3		13	Double Clearance No. 1
7	Phase 8		14	Double Clearance No. 2

2. Groupings of color coded wire for signal heads:

GROUP NUMBER	INDICATION	WIRE COLOR CODE*	GROUP NUMBER	INDICATION	WIRE COLOR CODE*
1	Red	14/19C-1-R	4	Red	14/19C-1-B/R
	Yellow	14/19C-1-O		Yellow	14/19C-1-O/R
	Green	14/19C-1-G		Green	14/19C-1-BL/R
	Ground Wire	14/19C-1-W		Ground Wire	14/19C-1-W/R

2	Red	14/19C-1-R/B	5	Red	14/19C-2-R
	Yellow	14/19C-1-O/B		Yellow	14/19C-2-O
	Green	14/19C-1-G/B		Green	14/19C-2-G
	Ground Wire	14/19C-1-W/B		Ground Wire	14/19C-2-W
3	Red	14/19C-1-R/W	6	Red	14/19C-2-R/B
	Yellow	14/19C-1-BL/W		Yellow	14/19C-2-O/B
	Green	14/19C-1-G/W		Green	14/19C-2-G/B
	Ground Wire	14/19C-1-B/W		Ground Wire	14/19C-2-W/B
GROUP NUMBER	INDICATION	WIRE COLOR CODE*	GROUP NUMBER	INDICATION	WIRE COLOR CODE*
7	Red	14/19C-2-R/W	11	Red	14/19C-3-R/W
	Yellow	14/19C-2-BL/W		Yellow	14/19C-3-BL/W
	Green	14/19C-2-G/W		Green	14/19C-3-G/W
	Ground Wire	14/19C-2-B/W		Ground Wire	14/19C-3-B/W
8	Red	14/19C-2-B/R	12	Red	14/19C-3-B/R
	Yellow	14/19C-2-O/R		Yellow	14/19C-3-O/R
	Green	14/19C-2-BL/R		Green	14/19C-3-BL/R
	Ground Wire	14/19C-2-W/R		Ground Wire	14/19C-3-W/R
9	Red	14/19C-3-R	13	Red	14/10C-1-R
	Yellow	14/19C-3-O		Yellow	14/10C-1-O
	Green	14/19C-3-G		Green	14/10C-1-G
	Ground Wire	14/19C-3-W		Ground Wire	14/10C-1-W
10	Red	14/19C-3-R/B	14	Red	14/10C-1-R/B
	Yellow	14/19C-3-O/B		Yellow	14/10C-1-O/B
	Green	14/19C-3-G/B		Green	14/10C-1-G/B
	Ground Wire	14/19C-3-W/B		Ground Wire	14/10C-1-W/B

**E. Groupings of Color Coded Wire for Preempts (Blue Light) and Pedestrian Signals:**

1. Preempts (Blue Light).

WIRE COLOR CODE	INDICATION
14/2C-1-B	Blue Light
14/2C-1-W	Ground Wire

2. Pedestrians Signals.

PED NUMBER	WIRE COLOR CODE*	INDICATION	PED NUMBER	WIRE COLOR CODE*	INDICATION
1	14/5C-1-P/R	DONT WALK	3	14/5C-3-P/R	DONT WALK
	14/5C-1-P/G	WALK		14/5C-3-P/G	WALK
	14/5C-1-P/B	Switch Wire		14/5C-3-P/B	Switch Wire
	14/5C-1-P/O	Switch Wire		14/5C-3-P/O	Switch Wire
	14/5C-1-P/W	Ground Wire		14/5C-3-P/W	Ground Wire



<b>2</b>	14/5C-2-P/R	DONT WALK	<b>4</b>	14/5C-4-P/R	DONT WALK
	14/5C-2-P/G	WALK		14/5C-4-P/G	WALK
	14/5C-2-P/B	Switch Wire		14/5C-4-P/B	Switch Wire
	14/5C-2-P/O	Switch Wire		14/5C-4-P/O	Switch Wire
	14/5C-2-P/W	Ground Wire		14/5C-4-P/W	Ground Wire

**\* Key for Wire Color Code:**

<b>XX</b>	<b>/</b>	<b>XXC</b>	<b>-</b>	<b>X</b>	<b>-</b>	<b>X</b>	<b>/</b>	<b>X</b>
AWG		No. of		Cable No.		Color		Tracer
		Conductors		For the Given		of Wire		Color
				Conductor Size				

Colors: R-Red, O-Orange, G-Green, BL-Blue, W-White, B-Black.

**F. Notes:**

The following steps should be used to determine the appropriate color coded wiring for a given signal installation:

1. Determine which functions are used in the signal operation.
2. Assign the color coded wire to the functions used in numerical order according to the priority given to the function .
3. Use the minimum number of conductors required to maintain the color code.

**EXAMPLE:** Signal X is a four phase signal

Step No.1-- Phase 1, 5, 6, 4, and an overlap of Phase 6 + 4 is used in the Signal operation.

Step No. 2--	Priority	Function	Color Coded Group No.
	1	5	1
	2	1	2
	3	6	3
	8	4	4
	9	Overlap No. 1	5

Step No.3-- Use one 19 conductor cable and one five conductor cable

**680-3.23 Pedestrian Push Button and Sign.** The push button and sign shall be installed and constructed in accordance with the details specified on the standard sheets. Push button and sign shall be installed on either an existing pole, a newly installed signal pole or on its own post and footing as specified on the plans.

The orientation shall be convenient to pedestrians intending to cross the street controlled by the push button at the marked or obvious crosswalk.

**680-3.24 Fire Pre-Emption Tell Tale Light.** The Tell Tale Light shall be installed in accordance with details on the standard sheets or as directed by the Engineer.

The light shall be wired in such a manner as to simultaneously display a blue light during the emergency pre-emption interval and at other times remain unlighted. It shall be oriented in the position which provides the best view to the emergency equipment approach roadway.

**680-3.25 Flashing Beacon Sign Assembly.** The flashing beacon sign assembly shall be constructed as shown on the plans, and standard sheets. It shall be installed on either an existing sign and post or a new pole as specified on the plans.

The sign panel shall be constructed in accordance with the appropriate subsections of Section 645, Signs. The flashing beacon signal heads and solid state flasher and cabinet shall be installed as shown on the standard sheets.

When not mounted behind guiderail, the pole shall be equipped with an approved breakaway base or transformer base fabricated in accordance with §723-15.01--Breakaway Transformer Base (Aluminum).

**680-3.26 Inductance Loop Installation.** Loops shall be installed in accordance with the details specified on the plans, Standard Sheets or as directed by the Engineer. Loop dimensions shall be as specified on the plans.

Pullboxes, conduits and curb cuts shall be completed before beginning the loop installation.

The loop shall be outlined on the pavement to conform to the specified configuration. A power saw and wet cutting techniques shall be used to cut a slot in the pavement. Dry cutting techniques shall be used if directed by the Engineer and with appropriate measures to safeguard nearby vehicle and pedestrian traffic. The cut shall be 3/8 inch in width and the depth specified on the standard sheets. The corners shall be cored, drilled or chipped out as shown on the standard sheets. Sharp edges in the corners shall be smoothed. All saw cuts and corners shall be of the same depth.

Immediately after sawing by either wet or dry methods, the slot and pavement shall be flushed with pressurized clean water to remove the saw slurry, dust or other cutting debris. Filtered compressed air shall be used to remove all dust and moisture from the slot. If the slot is damp, do not proceed with the installation until it is dry. Hot air may be used to dry the saw slot.

At the edge of pavement or curb a 1 inch minimum diameter, Metal Steel Conduit, Zinc Coated, Flexible Liquid-Tight Steel Conduit or Rigid Plastic Conduit shall be installed between the pavement and pullbox in accordance with details specified on the standard sheets. The curb or pavement shall be cut or scored to leave a permanent mark to show where the conduit runs under the curb or pavement.

The loop wire shall be installed starting at the roadside pullbox, passed around the loop for the specified number of turns and brought back to the pullbox. Splices shall not be permitted outside the pullbox. The wire shall be depressed in the slot without the use of sharp objects which might damage the wire insulation.

The loop shall be held in place every 2 feet with 1 inch (approximate) strips of rubber, neoprene, flexible tubing or foam backer rod as approved by the Engineer. These hold down strips shall be left in place when the slot is filled with Roadway Loop Embedding Sealer.

The pair of loop wires between the edge of pavement and the splice to the shielded lead-in cable in the pullbox shall be twisted together with at least five turns per 1 foot.

The splice between the loop wires (twisted pair) and the shielded lead-in cable shall be moisture proof and shall have a dielectric strength at least equal to that of the original insulation.

The bared conductor ends shall be either twisted and soldered or joined using an uninsulated, size coded solderless type connector of the correct size using an appropriate crimping tool. The splice shall be reinsulated in accordance with §680-3.16 Cable Splices, Method No. I except that heat shrinkage polyolefin tubing may be used as an alternate to the rubber tape; also, the first layer of PVC tape and sealing agent shall be extended as needed to cover a minimum of 1 inch of the inductance loop wire tube. The polyolefin tubing shall be at least as thick as the original insulation. Upon completion of the reinsulating, a final waterproof coating shall be applied over the entire splice.

The loop wires (twisted pair) and the splice to the shielded lead-in cable with the pullbox shall be held by wire hangers as near as possible to the top of the box in order to prevent their immersion in water. The shielded lead-in cable shall be continuous (no splices) from the splice to the loop wires to the controller cabinet terminals. The drain or ground wire in the shielded cable shall be grounded at the controller cabinet terminals only.

The completed loop installation including the shielded lead-in to the controller cabinet shall have a minimum of 50 megohms leakage resistance to ground. This resistance shall be tested before the loop is sealed in the pavement and after the splice is made between the loop wires (twisted pair) and shielded lead-in. Resistance to ground shall be tested in accordance with the Insulation Resistance Test in §680-3.32.

When it is determined that the resistance to ground requirements are met, the slot shall be filled with Roadway Loop Embedding Sealer. The pavement temperature shall be at least 40°F and rising before the sealer is placed. All work involving the sealer shall be done in compliance with the manufacturer's specifications. When the loop embedding sealer has set sufficiently to open the loop to traffic, but the surface remains tacky, the loop may be dusted with cement dust to facilitate opening the loop to traffic.

**680-3.27 Concrete Base for Controller Cabinet.** Bases shall be installed and constructed in accordance with the details specified on the standard sheets. Bases shall be either pre-cast or cast-in-place. Anchor bolts shall be placed in the footing at the proper location. Conduits shall be installed in the footing as required by the plans.

Where the base is installed in unpaved areas a work pad shall be constructed in front of the cabinet door.

Excavation shall be in accordance with §680-3.09, Excavation.

**680-3.28 Power Meter Base.** At each power source, the Contractor shall provide 6 feet of slack in the traffic signal cable used for power supply and neatly coil this slack within the controller cabinet.

The Contractor shall install a meter base as shown on the standard sheets or as ordered by the Engineer. The meter base will be furnished by the utility company. The additional length of power cable in the controller cabinet shall be extended through the cabinet wall into the meter base and back to the controller circuit breaker. All meter base fittings shall be weather tight.

**680-3.29 Overhead Traffic Signs.** Sign and mounting brackets shall be installed as shown on the plans and standard sheets. Signs shall be aligned to the satisfaction of the Engineer.

Sign Panels shall be aluminum and constructed in accordance with the appropriate subsections of section 645-Signs.

**680-3.30 Field Galvanizing.** All abrasions of galvanized steel due to handling equipment, erection, etc., and all points of attachment, shall be field repaired as specified in §719-01--Galvanized Coatings and Repair Methods.

**680-3.31 Cast Iron Junction Boxes.** Junction boxes shall be installed at the locations and according to the details on the plans or as directed by the Engineer. Dimensions shall be as shown on the plans.

**680-3.32 Tests.** The Contractor shall perform all tests described herein in the presence of the Engineer or his representative. Testing equipment shall be supplied by the Contractor.

Prior to placing a signal in operation, the Contractor shall perform the following tests:

**A. Continuity Test.** Each circuit shall be tested for continuity.

**B. Ground Test.** All traffic signal grounding systems when completed in place shall have a resistance to ground of not more than that shown in the table below as determined in the following manner:

1. Temporarily connect a 10 ampere load between the AC + side of the equipment cabinet fuse and the ground system. It should be assured that the power company applied voltage is 120 volts AC at the time of the test.
2. Disconnect the power company AC neutral from the ground system.
3. Connect a voltmeter between the power company AC neutral and the ground system.

<b>Controller Installed</b>	<b>Voltmeter Reading (Volts)</b>	<b>Equivalent Resistance (Ohms)</b>
2 Phase	20	2.0
Model 170 Microcomputer	20	2.0
All others	10	1.0

If the voltmeter reading is higher than the appropriate voltage shown in the above table under the 10 ampere load, the grounding system has an unacceptable resistance to ground. Additional grounding, including electrical bonding of underground metallic conduit, may be necessary in order to meet the requirements of this test.

**C. Insulation Resistance Test.** An insulation resistance test at 500 volts DC shall be made on each circuit between the circuit and ground. The insulation resistance shall not be less than 10 megohms on each circuit except that inductive loop detector circuits shall have an insulation resistance of not less than 50 megohms.

The insulation resistance test shall not be performed on magnetometer sensing elements. Splices in the pullbox adjacent to the magnetometer sensing elements shall not be made prior to performing an insulation resistance test on the lead-in conductors between the pullbox and the controller cabinet field terminals.

**D. Functional Test.** After satisfactory completion of all other tests, a functional test of the traffic signal control equipment shall be performed to demonstrate that every part of the signal system operates in accordance with the plans, specifications and to the satisfaction of the Engineer. The functional test for each signal system shall consist of not less than ten days of continuous satisfactory operation. If unsatisfactory performance of the system components is discovered during this time, the condition shall be corrected and the test repeated until ten days of continuous satisfactory operation is obtained.

Functional tests shall not begin on a Friday or on the day before a legal holiday. On the day the functional test begins, initial turn-on shall be made between the hours of 9:00 am and 2:00 pm unless otherwise ordered by the Engineer. Prior to turn-on all signal control equipment required for signal system shall be installed and ready for operation including pedestrian signal indications, pedestrian signs and push buttons, and vehicle detectors. All louvers, visors, and signal heads shall be directed to provide maximum visibility.

Temporary shut downs caused by power interruption or traffic accidents shall not constitute discontinuity of the functional test.

**680-3.33 Fiberoptic Pedestrian Signal Heads.** Fiberoptic pedestrian signal heads shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.34 Fiberoptic Dual Indication Arrow.** Fiberoptic dual indication arrows shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.35 Strobing Signal Section.** Strobing Signal Sections shall be installed according to the requirements of §680-3.21 Signal Heads.

**680-3.36 LED Traffic Signal Module.** LED Traffic Signal Modules shall be installed in Type I Traffic Signal Sections according to the requirements of §680-3.21 Signal Heads.

**680-3.37 LED Pedestrian Signal Module.** LED Pedestrian Signal Modules shall be installed in Type I Pedestrian Signal Section according to the requirements of §680-3.21 Signal Heads.

## 680-4 METHOD OF MEASUREMENT

**680-4.01 Each Unit.** The following items will be measured for payment as the number of each unit furnished and installed in accordance with the contract documents or as directed by the Engineer:

Span Wire Assembly	Traffic Signal Section
Guy Assembly	Strobing Signal Indication
Pedestrian Signal Section	Traffic Signal Bracket Assembly
Pullbox	Traffic Signal Disconnect Hanger
Cast Iron Junction Box	Riser Assembly
Controller Assembly Component	Traffic Signal Pole
Fire Pre-Emption Tell Tale Light	Overhead Sign Assembly
Concrete Base for Controller Cabinet	Flashing Beacon Sign Assembly
Fiberoptic Dual Indication Arrow	Fiberoptic Pedestrian Signal Section
LED Pedestrian Signal Module	LED Traffic Signal Module
Type I Pedestrian Signal Section	Type I Traffic Signal Section
Pedestrian Push Button and Sign	

**680-4.02 Linear Foot Measurements.** The following items will be measured for payment as the number of feet actually installed in accordance with the contract documents or as directed by the Engineer:

Inductance Loop Wire	Shielded Communication Cable
Shielded Lead-In Cable	Signal Cable with Integral Messenger
Inductance Loop Installation	Shielded Communication Cable w/ Integral Messenger
Messenger Assembly	Conduit
Signal Cable	

Inductance loop wire shall be the actual number of feet of wire used and left in place. Measurement of inductance loop installation shall be the number of feet of pavement sawcut.

**680-4.03 Pole Excavation and Concrete Foundation.** The payment quantity of pole excavation and concrete foundation shall be the number of cubic yard of concrete shown in the table on the standard sheet for Traffic Signal Pole Foundations for the specified footing size. No adjustment will be made when the Contractor elects to install a square footing. When a square footing is specified on the plans, the payment quantity shown in the table will be multiplied by a factor of 1.3.

**680-4.04 Conduit Jacking or Boring.** The quantity of conduit jacking or boring shall be the number of linear feet as computed from the payment limits specified in the contract documents.

## 680-5 BASIS OF PAYMENT

**680-5.01 General.** The unit price bid for all items of work encompassed by this Section shall include the furnishing of all labor, materials, tools, equipment, safety requirements as determined by U.S. Department of Labor's Occupational Safety and Health Standards, and incidentals as necessary to complete the work of the item installed in place and performing all tests to the satisfaction of the Engineer. No direct payment will be made for the installation of the power service connection and meter base but the cost shall be covered in the various traffic signal items. Items with additional provisions are as follows:

**680-5.02 Pedestrian Signal Section.** The unit price bid for each section shall include one "WALK" and one "DONT WALK" indication, and all necessary internal wiring, visor(s) and lamp(s).

**680-5.03 Pedestrian Signal Bracket Assembly.** The unit price bid for each bracket assembly shall include the bracket, fittings, wiring of the head assembly and installation.

**680-5.04 Pole Excavation and Concrete Foundation.** The unit price bid per cubic yard shall include the excavation, any protective system(s) required to ensure the safety of the workers and the public, backfill (select granular backfill or concrete), form work, concrete, bar reinforcement for concrete, excavation and backfilling of test holes, conduit bends and fittings, restoration of surfaces in kind, and sawcutting.

Progress payments will be made at the unit price bid for 80 percent of the quantity for each foundation properly installed except for the mesh installation and restoration. The remaining 20 percent will be paid for upon satisfactory completion of each footing.

**680-5.05 Pullbox.** The unit price bid for each pullbox shall include all concrete, reinforcing steel, crushed stone or gravel, extensions, sawcutting, excavation, backfill, frames, covers, restoration of surfaces and incidentals as required.

**680-5.06 Conduit.** The unit price bid shall include all handling, cutting, bending, fitting, capping, painting, testing, furnishing and placing pull lines, condulets and concrete inserts, expansion and incidental fittings as required. Conduit bends and fittings in concrete footings will be paid for under the respective footing item. Conduit excavation and backfill and jacking or boring will be paid for under their respective items.

**680-5.07 Inductance Loop Installation.** The unit price bid per linear foot shall include the cost of all pavement sawing and drilling, loop embedding sealer, and pavement cut-outs. Inductance Loop Wire, pullboxes, Shielded lead-in Cable, Vehicle Detector Inductance Loop, Conduit, and Conduit Excavation and Backfill shall be paid under their respective items.

**680-5.08 Controller Assembly.** The unit price bid for each component of the Controller Assembly shall include all labor, material and equipment necessary to complete the work. The cost of the necessary grounding system shall be included in the unit price bid for the controller assembly components.

Progress payments will be made in the following manner:

Sixty-five percent of the bid price of each component will be paid after it is installed and ready for testing.

Twenty-five percent of the bid price will be paid after satisfactory completion of all tests required by these specifications, including the function test for ten days of continuous satisfactory operation of the traffic signal system at each signalized location.

The remaining ten percent will be paid when all the traffic signals in the contract are functioning to the satisfaction of the Engineer.

**680-5.09 Fire Pre-Emption Tell Tale Light.** The unit price bid shall include the light fixture, bulb, nipple, guard, and all attachments and fittings as required.

**680-5.10 Concrete Base for Controller Cabinet.** The unit price bid for each base shall include the cost of all sawcutting, excavation, backfill, form work, restoration of surfaces, concrete, test holes, conduit bends and fittings, and concrete work pad.

**680-5.11 Pedestrian Push Button and Sign.** The unit price bid shall include the push button, sign, mounting hardware, pole drilling, and necessary fittings as required. Where the push button and sign is installed on its own post the unit price shall also include the cost of the post, sawcutting, excavation, backfill, concrete, restoration of surfaces, and conduit bend and fittings.

**680-5.12 Jacking or Boring.** The unit price bid per foot shall include excavation, backfilling for jacking or boring pits; test holes; and restoration of surfaces in kind.

**680-5.13 Signal Cable and Shielded Communication Cable.** The unit price bid per foot shall include the connectors, lashing or messenger rings or plastic cable bands, splices when permitted, testing, cable markers, and incidental fittings for the cable connected in place.

**680-5.14 Signal Cable with Integral Messenger and Shielded Communication Cable with Integral Messenger.** The unit price bid per foot shall include connectors, splices when permitted, testing, cable markers, hardware and fittings to attach the cable to the pole and other incidentals for the cable connected in place.

**680-5.15 Traffic Signal Sections.** The unit price bid shall include housing, visors, lamps, lenses and incidentals to make an individual signal head section.

**680-5.16 Traffic Signal Bracket Assembly.** The unit price bid shall include all brackets, elbows, arms and fittings to attach the signal to span wire, pole and mast arm. It shall include all labor and materials to assemble the individual signal sections and brackets to form a complete signal head including internal wiring and installation on the span wire, pole and mast arm.

**680-5.17 Traffic Signal Disconnect Hanger.** The unit price bid shall include the disconnect hanger, wiring to the signal head and signal cable and installation on the signal head.

**680-5.18 Traffic Signal Poles.** The unit price bid for each pole shall include all the items specified in §680-3.11 and the necessary grounding system, anchor bolts, mast arms, lighting arms, pole assembly and erections, and field galvanizing as required. Breakaway transformer bases when specified shall be included in the price bid for each pole.

**680-5.19 Overhead Sign Assembly.** The unit price bid shall include the mounting brackets attaching the sign to signal head, span wire, pole, and mast arm, sign panel and incidental hardware and fittings.

**680-5.20 Flashing Beacon Sign Assembly.** The unit price bid shall include the flashing beacon signal head, two circuit flasher and cabinet, sign panel and mounting brackets and all other necessary hardware. The cost of the pole and pole excavation and concrete foundation will be paid for under their respective items. The cost of any necessary breakaway base shall be included in the cost of the pole.

**680-5.21 LED Traffic Signal Module.** The unit price bid shall include the LED module, the removal of existing components if necessary, and installation of the LED module on the signal head.

**680-5.22 LED Pedestrian Signal Module.** The unit price bid shall include the LED module, the removal of existing components if necessary, and installation of the LED module on the pedestrian signal head.

**680-5.23 Type I Traffic Signal Section.** The unit price bid shall include housing, door, visor and incidentals to make an individual Type I Signal Head Section.

**680-5.24 Type I Pedestrian Signal Section.** The unit price bid shall include housing, door, visor and incidentals to make an individual Type I Pedestrian Signal Section.

**680-5.25 LED Traffic Signal Module Installation.** The unit price bid shall include the cost of labor, materials, and equipment required to remove existing components if necessary, and install the State supplied Traffic Signal Modules as shown on the plans or as ordered by the Engineer.

**680-5.26 LED Pedestrian Signal Module Installation.** The unit price bid shall include the cost of labor, materials, and equipment required to remove existing components if necessary, and install the State supplied Pedestrian Signal Modules as shown on the plans or as ordered by the Engineer.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
680.5001	Pole Excavation and Concrete Foundation	Cubic Yard
680.5002	Concrete Base for Controller Cabinet	Each
680.51XXYY	Pullbox	Each
	<i>XX= Size</i>	<i>YY= Type</i>
	<i>01 – 15 inch</i>	<i>01 - Reinforced Concrete</i>
	<i>02 - 18 inch</i>	<i>02 - Optional Reinforced</i>
	<i>03 - 24 inch</i>	<i>Concrete/Bituminous</i>
	<i>04 - 30 inch</i>	<i>Fiber</i>
	<i>05 - Rectangular 26 x 18 inch</i>	
	<i>06 - Rectangular 26 x 18 inch or 24 inch Diameter</i>	
	<i>07 - Rectangular 26 x 18 inch or 30 inch Diameter</i>	
680.5120	Cast Iron Junction Box	Each
680.52XXYY	Conduit	Foot
	<i>XX = Type</i>	<i>YY = Diameter</i>
	<i>01 - Metal Steel, Zinc Coated</i>	<i>01 - ½”</i>
	<i>02 - Flexible Liquid Tight Seal</i>	<i>02 - ¾”</i>
	<i>04 - PVC Coated Galvanized Steel</i>	<i>03 - 1”</i>
	<i>05 - Rigid Plastic, Class 1</i>	<i>04 - 1 1/4”</i>
	<i>06 - Rigid Plastic, Class 2</i>	<i>05 - 1 ½”</i>
	<i>07 - Rigid Plastic, Class 1 or 2</i>	<i>06 - 2”</i>
	<i>08 - Flexible, Liquidtight PVC</i>	<i>07 - 2 1/2”</i>
	<i>09 – PVC Schedule 80, 4 Ducts</i>	<i>08 - 3”</i>
	<i>10 - Fiberglass – Multi-Cell-4 Duct</i>	<i>09 - 3 ½”</i>
	<i>80 – PVC Schedule 80</i>	<i>10 - 4”</i>
		<i>12 – 5”</i>
		<i>13 – 6”</i>
680.53	Conduit Jacking or Boring	Foot
680.54	Inductance Loop Installation	Foot
680.56	Emergency Pre-emption System	Each
680.60XXYY	Traffic Signal Pole--Span Wire	Each
680.61XXYY	Traffic Signal Pole--Span Wire with Lighting Arm	Each
	<i>XX = Load in kips (1, 2, 3, 4, ...)</i>	
	<i>YY = Length in whole feet *</i>	
680.62XXYY	Traffic Signal Pole--Mast Arm	Each
680.63XXYY	Traffic Signal Pole--Dual Mast Arm**	Each
680.64XXYY	Traffic Signal Pole--Mast Arm with Lighting Arm	Each
680.65XXYY	Traffic Signal Pole--Dual Mast Arm** with Lighting Arm	Each
	<i>XX=Mast arm mounting height in feet*</i>	
	<i>YY=Mast arm length in whole feet</i>	
680.67XXYY	Traffic Signal Pole--Post Top Mount	Each



680.68XXYY	Traffic Signal Pole--Bracket Mount	Each
680.69XX	Traffic Signal Pole Bracket Mount with Lighting Arm	Each
	<i>XX=Mounting height in feet*</i>	
	<i>YY=Type</i>	
	<i>01-Steel</i>	
	<i>02-Aluminium</i>	
680.7001	Single Span Wire Assembly	Each
680.7002	Dual Span Wire Assembly with Upper Tether Wire	Each
680.7003	Dual Span Wire Assembly with Lower Tether Wire	Each
680.7004	Messenger Assembly	Foot
680.7005	Guy Assembly	Each
680.700602	Riser Assembly, 1/2 inch Diameter	Each
680.700603	Riser Assembly, 1 inch Diameter	Each
680.700604	Riser Assembly, 1 1/2 inch Diameter	Each
680.700606	Riser Assembly, 2 inch Diameter	Each
680.700607	Riser Assembly, 2 1/2 inch Diameter	Each
680.700608	Riser Assembly, 3 inch Diameter	Each
680.700609	Riser Assembly, 3 1/2 inch Diameter	Each
680.700610	Riser Assembly, 4 inch Diameter	Each
680.700612	Riser Assembly, 5 inch Diameter	Each
680.700613	Riser Assembly, 6 inch Diameter	Each
680.71	Shielded Lead-in Cable	Foot
680.72	Inductance Loop Wire	Foot
680.73XXYY	Signal Cable	Foot
680.74XXYY	Signal Cable with Integral Messenger	Foot
	<i>XX = Number of Conductors</i>	
	<i>YY = Wire Gauge</i>	
680.75XXYY	Shielded Communication Cable	Foot
680.76XXYY	Shielded Communication Cable with Integral Messenger	Foot
	<i>XX = Number of Pairs</i>	
	<i>YY = Wire Gauge</i>	
680.810101	Traffic Signal Module - 12 inch, Red Ball, LED	Each
680.810102	Traffic Signal Module - 12 inch, Red Arrow, LED	Each
680.810103	Traffic Signal Module-12 inch Yellow Ball, LED	Each
680.810104	Traffic Signal Module-12 inch Yellow Arrow, LED	Each
680.810105	Traffic Signal Module - 12 inch, Green Ball, LED	Each
680.810106	Traffic Signal Module - 12 inch, Green Arrow, LED	Each
680.810107	Traffic Signal Section - Type I, 12 inch	Each
680.810108	Traffic Signal Module - 12 inch, Bi-Modal Yellow/Green Arrows, LED	Each
680.8102	Traffic Signal Section, Optically Programmed - 12 inch	Each
680.810301	Traffic Signal Module - 8 inch, Red Ball, LED	Each
680.810302	Traffic Signal Module - 8 inch, Red Arrow, LED	Each
680.810303	Traffic Signal Module- 8 inch Yellow Ball, LED	Each
680.810304	Traffic Signal Module- 8 inch Yellow Arrow, LED	Each
680.810305	Traffic Signal Module - 8 inch, Green Ball, LED	Each
680.810306	Traffic Signal Module - 8 inch, Green Arrow, LED	Each
680.810307	Traffic Signal Section - Type I, 8 inch	Each
680.810308	Install Ball/Arrow LED Traffic Signal Module	Each

680.810601	Traffic Signal Section - Polycarbonate, Type I, 12 inch	Each
680.810701	Traffic Signal Section - Polycarbonate, Type I, 8 inch	Each
680.8111	Traffic Signal Bracket Assembly 1 Way	Each
680.8112	Traffic Signal Bracket Assembly 2 Way	Each
680.8113	Traffic Signal Bracket Assembly 3 Way	Each
680.8114	Traffic Signal Bracket Assembly 4 Way	Each
680.8115	Traffic Signal Bracket Assembly 5 Way	Each
680.8120	Traffic Signal Disconnect Hanger	Each
680.813101	Pedestrian Signal Module - 12 inch, Hand Symbol, LED	Each
680.813102	Pedestrian Signal Module - 12 inch by 12 inch MAN LED	Each
680.813103	Pedestrian Signal Section - Type I, 12 inch	Each
680.813104	Install LED Pedestrian Signal Module	Each
680.813105	Pedestrian Signal Module - 12 inch, Bi-Modal Hand/Man Symbols, LED	Each
680.813106	Pedestrian Signal Section - Polycarbonate, Type I, 12 inch	Each
680.813107	Pedestrian Signal Module – 16 inch by 18 inch Bi-Modal HAND/MAN LED	Each
680.813108	Pedestrian Signal Section, Type I - for 16 inch by 18 inch LED module	Each
680.813109	Pedestrian Signal Section - Polycarbonate, Type I- for 16 inch by 18 inch LED module	Each
680.8141	Pedestrian Signal Bracket Mount Assembly	Each
680.8142	Pedestrian Signal Post Top Mount Assembly	Each
680.82XX	Overhead Sign Assembly	Each
	<i>XX = Type</i>	
680.8220	Flashing Beacon Sign Assembly	Each
680.8225	Pedestrian Push Button and Sign - without Post	Each
680.8226	Pedestrian Push Button and Sign - with Post	Each
680.8230	Fire Pre-Emption Tell Tale Light	Each

**NOTE:** SEE PAY ITEM CATALOG FOR ITEM NUMBERS CONTAINING VARIABLES.

\* Mast arm mounting heights, and span wire pole length and load, are as defined on the `Standard Traffic Signal Poles' standard sheets and in §724-03, Traffic Signal Poles. The nominal luminaire mounting height and span shall be as indicated on the plans.

\*\* The mast arm length and mounting height indicated by the item number is for only one of the mast arms. The other mast arm length and mounting height shall be as indicated on the plans.

## **SECTION 681 AND 682 (VACANT)**

## **SECTION 683 - INTELLIGENT TRANSPORTATION SYSTEMS**

**683-1 DESCRIPTION.** The work in this section shall include work required for intelligent transportation systems.

**683-2 MATERIALS.** Materials shall be as specified in the special specifications.

**683-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**683-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**683-5 BASIS OF PAYMENT.** As specified in the special specifications.

## **SECTION 684 (VACANT)**

## **SECTION 685 - EPOXY REFLECTORIZED PAVEMENT MARKINGS**

**685-1 DESCRIPTION.** Under this work, the Contractor shall furnish and apply epoxy reflectORIZED pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the MUTCD and these specifications.

The epoxy marking material should be hot-applied by spray methods onto bituminous and portland cement concrete pavement surfaces at the thickness and width shown on the Contract Documents. Following an application of glass beads, the cured epoxy marking shall be an adherent reflectORIZED stripe.

**685-2 MATERIALS.** Materials shall conform to the requirements of §727-03 White and Yellow Epoxy ReflectORIZED Pavement Markings.

### **685-3 CONSTRUCTION DETAILS**

**685-3.01 General.** All pavement markings and patterns shall be placed as shown on the Contract Documents and in accordance with the MUTCD.

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director and his/her authorized representative.

At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer's written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.

When pavement markings are applied under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

When necessary the Contractor shall establish marking line points at 30 feet intervals throughout the length of the pavement or as directed by the Engineer.

**685-3.02 Atmospheric Conditions.** Epoxy pavement markings shall only be applied during conditions of dry weather and on substantially dry pavement surfaces. At the time of installation the pavement surface temperature shall be minimum of 50°F and the ambient temperature shall be a minimum of 50°F and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

**685-3.03 Surface Preparation.** The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the epoxy markings application.

At the time of application, all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new portland cement concrete surfaces and existing painted pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for in accordance with Section 635, Cleaning and Preparation of Pavement Surfaces for Pavement Markings.

**685-3.04 Epoxy Applying Equipment.** Mobile applying equipment for the placement of epoxy reflectorized pavement markings shall be approved by the Director (Materials Bureau) prior to the start of work.

In general, a mobile applicator shall be a truck mounted, self-contained pavement marking machine, specifically designed to apply epoxy resin materials and reflective glass spheres in continuous and skip-line patterns. The applying equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc. In addition, the truck mounted unit shall be provided with accessories to allow for the marking of legends, symbols, crosswalks, and other special patterns.

At any time throughout the duration of the project, the Contractor shall provide free access to his epoxy applying equipment for inspection by the Engineer or his authorized representative.

The Engineer may approve the use of a portable applicator in lieu of mobile truck mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these specifications. The applying equipment shall be capable of installing a minimum of 100,000 feet of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual tanks for the storage of Part A and Part B of the epoxy resin and for the storage of reflective glass spheres.
2. Heating equipment of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.
3. Glass bead dispensing equipment and the capacity of applying the spheres a minimum rate of 20 lb/gal of epoxy resin composition.
4. Metering devices or pressure gauges on the proportioning pumps, positioned to be readily visible to the Engineer.
5. All necessary spray equipment, mixers, compressors, and other appurtenances for the placement of epoxy reflectorized pavement markings in a simultaneous sequence of operations as described in §685-3.05 Application of Epoxy Reflectorized Pavement Markings.

**685-3.05 Application of Epoxy Reflectorized Pavement Markings.** Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated by the Contract Documents.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions and pavement surface temperature are acceptable to the Engineer.

Pavement markings shall be applied by the following simultaneous operation:

1. The pavement surface is air-blasted to remove dirt and residues.
2. The epoxy resin, mixed and heated in accordance with the manufacturer's recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness.
3. Reflective glass spheres are injected into, or dropped onto, the liquid epoxy marking at a minimum rate of 20 lb/gal of epoxy resin.

**685-3.06 Defective Epoxy Pavement Markings.** Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer as follows:

1. Insufficient film thickness and line width; insufficient glass bead coverage or inadequate glass bead retention.

*Repair Method.* Prepare the surface of the defective epoxy marking by grinding or blast cleaning. No other cleaning methods will be allowed. Surface preparation shall be performed to the extent that a substantial amount of the reflective glass spheres are removed and a roughened epoxy marking surface remains. Immediately after surface preparation remove loose particles and foreign debris by brooming or blasting with compressed air. Repair shall be made by restriping over the cleaned surface in accordance with the requirements of this specification and at the full thickness indicated on the Contract Documents.

2. Uncured or discolored epoxy\*; insufficient bond (to pavement surface or existing durable marking).

*Repair Method.* The defective epoxy marking shall be completely removed and cleaned to the underlying pavement surface in accordance with the requirements of Section 635 - Cleaning and Preparation of Pavement Surfaces, at the Contractor's expense. The extent of removal shall be the defective area plus any adjacent epoxy pavement marking material extending three feet in any direction. After surface preparation work is complete, repair shall be made by reapplying epoxy over the cleaned pavement surface in accordance with the requirements of this specification.

\*Uncured epoxy shall be defined as applied material that fails to cure (dry) in accordance with requirements of §727-03 MATERIAL REQUIREMENTS, A., 2.0 paragraph d. Drying Time (Field); or applied material that fails to cure (dry) within a reasonable time period under actual field conditions, as defined by the Engineer.

\*Discoloration shall be defined as localized areas or patches of brown, grayish or black colored epoxy marking material. These areas often occur in a cyclic pattern and often are not visible until several days or weeks after markings are applied.

Other defects not noted above, but determined by the Engineer to need repair, shall be repaired or replaced as directed by and to the satisfaction of the Engineer.

All work in conjunction with the repair or replacement of defective epoxy reflectorized pavement markings shall be performed by the Contractor at no additional cost to the State.

**685-4 METHOD OF MEASUREMENT.** Pavement striping will be measured in feet along the centerline of the pavement stripe and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: "SCHOOL" would be paid as six units. Double and triple headed arrows will be measured as a single unit, but the "X" in railroad grade crossing markings (MUTCD Figure 8B-6) will be measured by feet of 4 inch stripe.

**685-5 BASIS OF PAYMENT.** The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

No payment will be made for the repair or replacement of defective epoxy reflectorized pavement markings.

No payment will be made for the number of feet of skips in the dashed line.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
685.01	White Epoxy Reflectorized Pavement Stripes – 15 mils	Feet
685.02	Yellow Epoxy Reflectorized Pavement Stripes – 15 mils	Feet
685.03	White Epoxy Reflectorized Pavement Letters – 15 mils	Each
685.04	White Epoxy Reflectorized Pavement Symbols – 15 mils	Each
685.11	White Epoxy Reflectorized Pavement Stripes – 20 mils	Feet
685.12	Yellow Epoxy Reflectorized Pavement Stripes – 20 mils	Feet
685.13	White Epoxy Reflectorized Pavement Letters – 20 mils	Each
685.14	White Epoxy Reflectorized Pavement Symbols – 20 mils	Each

**SECTION 686 (VACANT)**

**SECTION 687 - THERMOPLASTIC REFLECTORIZED PAVEMENT MARKINGS**

**687-1 DESCRIPTION.** Under this work, the Contractor shall furnish and apply thermoplastic reflectorized pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the MUTCD and these specifications.

The thermoplastic pavement marking compound shall be extruded in a molten state onto the pavement surface. Following surface application of glass beads and upon cooling to normal pavement temperatures, the resultant marking shall be an adherent reflectorized stripe of the specified thickness and width that is capable of resisting deformation by traffic.

**687-2 MATERIALS.** Materials shall conform to the requirements of §727-01 White and Yellow Thermoplastic Reflectorized Pavement Markings.

**687-3 CONSTRUCTION DETAILS**

**687-3.01 Equipment General.** Thermoplastic applying equipment shall be approved by the Engineer prior to the start of work.

Unless otherwise approved by the D.C.E.C., all projects specifying quantities greater than 65,000 feet of longitudinal pavement marking lines will be striped using only mobile applying equipment for the longitudinal lines. Longitudinal pavement marking lines are Broken Lines (skipline), Edge Lines, Barrier Lines, and Solid Lines as defined by the MUTCD. Portable applying equipment will be acceptable for placing all other markings on these projects.

Thermoplastic material shall be applied to the pavement surface by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for maintaining the temperature and controlling the flow of material (Note 1.)

*Note 1.* Alternate types of extrusion devices may be considered acceptable for use upon prior approval by the Materials Bureau. Requests for approval of alternate extrusion applying equipment shall be made to the Materials Bureau by the Contractor/Manufacturer at least 90 days prior to its date of intended use. Detailed requirements and procedures for the acceptance of alternate equipment are available from the Materials Bureau.

For heating the thermoplastic composition, the application equipment shall include a melting kettle(s) of such capacity as to allow for continuous marking operations. The melting kettle(s) may be mounted on a separate “supply” vehicle or included as part of the mobile applying equipment. The kettle(s) shall be capable of heating the thermoplastic composition temperatures greater than 400°F. The heating mechanism shall be by means of a thermostatically controlled heat transfer medium. Heating of the

composition by direct flame will not be allowed. Material temperature gauges shall be visible at both ends of the kettle(s).

Application equipment shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be so constructed so as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that all mixing and conveying parts up to and including the extrusion shoe(s), maintain the material at the required plastic temperature.

The applying equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying “skip” lines. The equipment shall be capable of applying varying widths of traffic markings.

The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow.

The bead dispenser shall be automatically operated in such a manner that it will only dispense beads while the composition is being applied.

Applying equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

Applicators shall be equipped and constructed in such a manner as to satisfy the requirements of the National Board of Fire Underwriters and the appropriate agencies of the State of New York.

The equipment used for the placement of thermoplastic pavement markings shall be two general types: mobile applicator and portable applicator.

**687-3.02 Mobile Applying Equipment.** The mobile applicator shall be defined as a truck mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by the extrusion method. The unit shall be equipped to apply the thermoplastic material at temperatures exceeding 400°F, and at the widths and thicknesses specified herein. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 feet of longitudinal markings in an 8-hour day.

The mobile unit shall be equipped with a melting kettle(s) or materials storage reservoir(s) of such capacity as to allow for continuous marking operations. The kettle(s) or reservoirs shall be capable of heating or holding the thermoplastic composition at temperatures greater than 400°F.

The mobile unit shall be equipped with an extrusion shoe(s), and shall be capable of marking edgeline and centerline stripes. The extrusion shoe(s) shall be closed, heat jacketed or suitably insulated unit; shall hold the molten thermoplastic at a temperature greater than 400°F; and shall be capable of extruding a line between 3 to 8 inches in width; and at a thickness of not less than 1/8 inch nor more than 3/16 inch, and of generally uniform cross section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

The mobile unit shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

**687-3.03 Portable Applying Equipment.** The portable applicator shall be defined as hand operated equipment, specifically designed for placing thermoplastic installations such as crosswalks; stop bars; legends; arrows; and short lengths of lane, edge, and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettle(s). The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at temperatures greater than 400°F, of extruding a line of from 3 to 8 inches in width, and in thickness of not less than 1/8 inch nor more than 3/16 inch and of generally uniform cross-section.

Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

**687-3.04 Application General.** All pavement markings shall be placed as shown on the plans and in accordance with the MUTCD.

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director or his authorized representative.

When pavement markings are applied under traffic the Contractor shall provide all necessary flags, markers, signs, etc. to maintain and protect traffic; and to protect marking operations and the markings until thoroughly set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, tracking marks, spilled thermoplastic or thermoplastic applied in unauthorized areas.

When necessary, the Contractor shall establish marking line points at 30 feet intervals throughout the length of pavement or as directed by the Engineer.

**687-3.05 Atmospheric Conditions.** Thermoplastic pavement markings shall be placed upon dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 55°F and the ambient temperatures shall be a minimum of 50°F and rising. The Engineer will determine when atmospheric conditions are such to produce satisfactory results (Note 2).

*Note 2.* To comply with the 55°F pavement surface temperature requirement, it will benefit the Contractor to schedule striping work for seasons of warm weather when possible. In cooler conditions, striping operations may be coordinated with bituminous paving work to take advantage of residual heat, providing that the ambient temperature requirements of §687-3.05 are still met.

### **687-3.06 Materials Application Requirements**

**A. Thermoplastic Primer.** All pavement surfaces shall be primed except that on new bituminous pavements, when the thermoplastic pavement markings are applied within the same calendar year as the completion of paving operations, primer shall not be required.

The primer shall be either a one-component or a two-component, cold or hot applied material of the type recommended by the manufacturer of the thermoplastic pavement marking material. At least five working days prior to the start of thermoplastic application, the Contractor shall provide the Engineer with the manufacturer's written instructions for primer application. The application of the primer shall be performed in accordance with the manufacturer's written recommendations which shall include the method of application, the application rate, and the drying time.

#### **B. Thermoplastic Composition.**

**1. Application Temperature** - thermoplastic composition shall be applied at temperatures no lower than 400°F at the point of deposition. For purposes of these specifications, the point of deposition shall be defined as within the extrusion shoe.

**2. Extruded Markings** - all extruded markings shall be applied at the specified width, and at a thickness of not less than 1/8 inch nor more than 3/16 inch.

**C. Reflective Glass Spheres (for Drop-On).** Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 lb per 20 square feet of composition.



**687-3.07 Surface Cleaning and Preparation of Pavement.** The Contractor shall be responsible for cleaning the pavement surface to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the thermoplastic markings application.

At the time of application all pavement surfaces shall be free of oil dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new Portland Cement concrete surfaces; and existing pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and paid for under separate items.

**687-3.08 Application of Thermoplastic Pavement Markings.** All special markings, cross walks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator. Unless otherwise specified in the contract documents all center line, skip line, edge line and other longitudinal type markings may be applied with either a portable or a mobile applicator.

When the surface preparation work has been completed, if applicable, the bituminous and/or concrete pavement surface shall be primed according to the manufacturer's written instructions. Primer shall not be required on new bituminous pavement surfaces that are completed within the same calendar year as the thermoplastic marking application. The primer shall be spray applied onto the pavement surface and allowed to dry according to the manufacturer's written instructions. Pavement surfaces that are primed and not striped with thermoplastic within the required drying time or within the same work day shall be re-primed.

After the primer has dried, the thermoplastic shall be applied at composition temperatures no lower than 400°F at the point of deposition. Immediately after installation of the thermoplastic, drop-on reflective glass spheres shall be mechanically applied such that the spheres are held by and embedded in the surface of the molten composition.

**687-4 METHOD OF MEASUREMENT.** Pavement striping will be measured by linear foot along the centerline of the pavement stripe, and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inch as shown on the plans or as directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

No payment will be made for the number of feet of skips in the dashed line.

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or symbol. Example: "SCHOOL" would be measured as six units. Double and triple headed arrows will be measured as a single unit, but the "X" in railroad grade crossing markings (MUTCD Figure 8B-6) will be measured by feet of 4 inch stripe.

**687-5 BASIS OF PAYMENT.** The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost for maintaining and protecting traffic during the marking operations shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
687.0101	White Thermoplastic Reflectorized Pavement Stripes	Feet
687.0201	Yellow Thermoplastic Reflectorized Pavement Stripes	Feet

687.0301	White Thermoplastic ReflectORIZED Pavement Letters	Each
687.0401	White Thermoplastic ReflectORIZED Pavement Symbols	Each

## SECTION 688 - PREFORMED REFLECTORIZED PAVEMENT MARKINGS

**688-1 DESCRIPTION.** Under this work, the Contractor shall furnish and apply preformed reflectORIZED pavement markings at the location and in accordance with patterns indicated on the plans or as ordered by the Engineer, and in conformance with the MUTCD and these specifications.

The preformed reflectORIZED pavement marking shall be applied on new and existing bituminous and portland cement concrete surfaces by hand and mechanical methods. The resultant marking shall be an adherent reflectORIZED stripe that is capable of molding itself to the contours of the pavement surface and of resisting deformation by traffic.

**688-2 MATERIALS.** Materials shall conform to the requirements of §727-04 White and Yellow ReflectORIZED Pavement Markings.

### 688-3 CONSTRUCTION DETAILS

**688-3.01 General.** All pavement markings and patterns shall be placed as shown on the plans and in accordance with the MUTCD.

Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Regional Director or his authorized representative.

At least five (5) days prior to the start of work, the Contractor shall provide the Engineer with the manufacturer's written instructions for the application of preformed marking and primer materials.

When pavement markings are applied under traffic, the Contractor shall supply all necessary flags, markers, signs, and other devices, to maintain traffic and to protect the markings until set.

The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow will not be allowed without prior approval of the Engineer.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, preformed markings applied in unauthorized areas.

When required by the Engineer, the Contractor shall establish marking line points at 30 feet intervals throughout the length of the pavement or as directed by the Engineer.

**688-3.02 Application Methods.** Preformed pavement markings shall be applied by the following methods. The installation of markings on the project may be performed simultaneously by more than one method.

**A. During Bituminous Paving Operations.** Preformed markings shall be applied on newly paved bituminous surfaces after finish rolling is complete.

**B. On Completed Pavements.** Preformed markings shall be applied on new and existing bituminous and portland cement concrete pavement surfaces as prescribed in §688-3.03 Weather and Seasonal Limitations.

**688-3.03 Weather and Seasonal Limitations.** The Engineer shall determine as to when temperature and pavement surface conditions are such as to produce satisfactory results.

Preformed pavement markings shall be placed upon dry pavement surfaces; pavements exposed to rain or wet conditions shall be allowed to thoroughly dry before marking application.

Preformed markings applied in conjunction with §688-3.02A, *During Bituminous Paving Operations*, shall only be placed within the seasonal limitations of Standard Specification §402-3.01. The bituminous

pavement surface temperature shall, at all times, be the controlling temperature at which preformed markings are placed, and shall be between 100°F and 170°F.

Preformed markings applied in conjunction with §688–3.02B, *on completed pavements*, shall be applied within the seasonal limitations of Table 688-1, Temperature and Seasonal Requirements. The pavement surface and ambient air temperatures in Table 688-1 shall, in all cases, be the controlling temperatures at which preformed markings are placed. Marking application work shall be discontinued when temperatures fall below the specified requirements.

<b>TABLE 688-1 TEMPERATURE AND SEASONAL REQUIREMENTS</b> <b>(§688–3.02b. ON COMPLETED PAVEMENTS)</b>			
<b>Geographic Location</b>	<b>Pavement Surface Temperature</b>	<b>Ambient Air Temperature</b>	<b>Allowable Installation Dates</b>
Regions 1, 2, 3, 4, 5, 6, 7 & 9 (All Counties) Region 8 (Ulster County only)	70°F, Min.	60°F, Min.	May 15 to September 1
Regions 8 & 10 (except Ulster County)	70°F, Min.	60°F, Min.	May 15 to September 15
Region 11	70°F, Min.	60°F, Min.	May 1 to September 30

**NOTES:**

1. Surface temperatures shall be measured on the pavement surface where the preformed markings are to be placed. The controlling temperature shall be the average of three temperature readings taken at locations 100± feet apart.
2. Ambient air temperatures shall be measured in the shade.

**688-3.04 Mechanical Applying Equipment.** Mechanical applying equipment for the placement of preformed pavement marking stripes shall be of the type recommended by the manufacturer of the preformed material. All applying equipment shall be approved by the Engineer prior to the start of work.

**688-3.05 Rollers.** Preformed markings applied in conjunction with §688-3.02a, during bituminous paving operations, shall be rolled into place with compaction equipment meeting the requirements of Standard Specification §402-3.04. Vibratory roller models shall operate in a 'static' mode.

Preformed markings applied in conjunction with §688-3.02B., *On Completed Pavements*, shall be rolled into place using steel shell or pneumatic rubber-tired roller equipment approved by the Engineer. Steel wheel rollers shall weigh a minimum of 200 lbs on each axle. Pneumatic rubber-tired rollers shall exert a minimum tire compression on the pavement of 28 psi. Hand rollers or rubber tired vehicles (e.g. pick-up truck) meeting the above requirements may be suitable for use.

**688-3.06 Primer Requirements.** When required, primer or adhesive shall be used for marking applications in accordance with the written recommendations of the manufacturer of the preformed marking material.

Primer materials shall be placed at the application rate and by the application methods recommended by the manufacturer.

When primer is applied, the area of application shall be at least the width or dimension, of the new preformed marking, plus one inch on each side.

**688-3.07 Surface Cleaning and Preparation of Pavement Surfaces.** The Contractor shall be responsible for cleaning the pavement surface to the satisfaction of the Engineer.

Surface cleaning and preparation work shall be performed only in the area of the preformed markings application.

At the time of application, all pavement surfaces shall be free of oil, dirt, dust, grease and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.

In addition, concrete curing compounds on new portland cement concrete surfaces and existing pavement markings on both concrete and bituminous pavement surfaces shall be removed and paid for under separate items.

**688-3.08 Application of Preformed Reflectorized Pavement Markings.** Unless otherwise approved by the Engineer, all longitudinal lines shall be applied using mechanical applying equipment. Transverse and special marking patterns may be applied by hand or mechanical methods.

Preformed marking operations shall not begin until after the pavement surface has been cleaned and prepared.

Preformed stripes shall not be applied over longitudinal paving joints or over the point of transition between the pavement surface and adjoining shoulder. The placement of stripes in the area of transition shall be either on the pavement or on the shoulder, as directed by the Engineer.

No roller shall operate in excess of 3.0 mph. One roller pass shall be defined as one movement of the roller over any point of the preformed marking, in the direction of the marking application.

**A. Application During Bituminous Paving Operations.** The application of preformed markings shall not begin until finish rolling of the new bituminous pavement is complete.

At the time of marking application, the surface temperature of the new bituminous pavement shall be between 100°F and 170°F. The Contractor shall coordinate paving and preformed marking operations to conform with surface temperature requirements.

Immediately after finish rolling is complete, the preformed marking shall be applied on the new bituminous surface. Traces of water or other residue from finish rolling operations shall first be removed. Immediately after its placement, the preformed marking shall be adhered to the warm pavement surface by rolling. Rollers shall make a minimum one pass, and operate in the same direction that the marking was applied. Diagonal, reverse or crosswise rolling will not be allowed. The minimum one pass may be increased by the Engineer if, in his opinion, the desired adherence is not obtained.

**B. Application on Completed Pavements.** The application of preformed markings shall only be performed within the limitations of §688–3.03 Weather and Seasonal Limitations.

If required by the manufacturer, primer and adhesive activators shall be applied and allowed to dry in accordance with the instructions of the manufacturer of the preformed material.

The preformed marking shall be placed on the pavement surface and adhered by rolling. Rollers shall make a minimum of one pass, and operate in the same direction that the marking was applied. Diagonal, reverse or crosswise rolling will not be allowed. The minimum one pass may be increased by the Engineer if, in his opinion, the desired adherence is not obtained.

**688-4 METHOD OF MEASUREMENT.** Pavement striping will be measured by feet along the centerline of the pavement stripe and will be based on a 4 inch wide stripe.

The preformed pavement markings will be inspected during and following installation to determine conformance with this specification. In addition, they will be inspected following a performance period that will extend for 180 calendar days following both their installation and opening of the roadway to traffic.

Within 15 consecutive calendar days after the end of the 180 day performance period, a final performance inspection will be made by the Engineer. If this inspection discloses any work, in whole or in part, as not being visibly intact and serviceable to the following extent, the Contractor shall completely repair or replace such work:

**A. Broken Line.** 90 percent measured longitudinally of the total length of all broken lines in any 500 feet long pavement section.

**B. Dotted Line.** 50 percent measured longitudinally of the total length of all dotted lines in any 100 feet long pavement section.

**C. Solid Line and Edge Line.** 90 percent measured longitudinally of the total length of solid line or edge line in any 500 feet long pavement section.

**D. Channelizing Line, Stop Line, Crosswalk Lines, Clearance Line and Crossbars, Hatch Lines, Letters and Symbols.** 90 percent by area of any individual line, letter or symbol.

When required all repair or replacement work shall be performed in accordance with this specification and completed within 60 calendar days of the earliest allowable installation date as specified in Table 1, for that location. The Engineer shall determine the limits or quantity of preformed to be repaired or replaced.

Upon completion of the final performance inspection, or after satisfactory completion of any necessary corrections, the Engineer will, within 10 calendar days, notify the Contractor in writing, of the date of such final performance inspection and release the Contractor from further performance responsibility.

Pavement striping on-going projects will be measured as the total of the striping applied, if after the final 180 day performance period, damage to the striping is not in excess of that specified (e.g. If 95% of the edgeline striping is intact in a 500 feet pavement section, the edgeline will be measured as the full 500 feet of applied marking. No deduction will be made for the damaged 5% (25 feet) of striping).

Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or as directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Feet}}{4 \text{ inches}}$$

No payment will be made for the number of feet of gaps between broken or dotted line segments.

Letters and symbols will be measured by each unit applied. A unit will consist of one letter or one symbol. Example: "SCHOOL" would be measured as six units.

Double and triple headed arrows will be measured as a single unit, but the "X" in railroad grade crossing markings (MUTCD Figure 8B-6) will be measured by feet of 4 inch stripe.

**688-5 BASIS OF PAYMENT.** The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment to satisfactorily complete the work. The cost of cleaning pavement surfaces of oil, dirt, dust, grease and similar foreign materials shall be included in the price bid. The cost of removal of concrete curing compounds and existing pavement markings will be paid under separate items and are not included in this item.

**Payment will be made under:**

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
688.01	White Preformed Reflectorized Pavement Stripes	Feet
688.02	Yellow Preformed Reflectorized Pavement Stripes	Feet
688.03	White Preformed Reflectorized Pavement Letters	Each
688.04	White Preformed Reflectorized Pavement Symbols	Each

## **SECTION 689 (VACANT)**

## SECTION 690 - SPECIALTY WORK

**690-1 DESCRIPTION.** The work in this section shall include specialty work required for transportation projects.

**690-2 MATERIALS.** Materials shall be as specified in the special specifications.

**690-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**690-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**690-5 BASIS OF PAYMENT.** As specified in the special specifications.

## SECTIONS 691 THRU 695 - (VACANT)

## SECTION 696 - CONTRACTOR CHARGES (for Construction's use only)

**696-1 DESCRIPTION.** This section will provide for the accounting of charges assessed against the Contractor in accordance with the contract documents.

**696-2 MATERIALS.** None specified.

**696-3 CONSTRUCTION DETAILS.** The Department may assess the Contractor charges for Engineering Charges and/or Liquidated Damages against monies due the Contractor in accordance with §108-03 *Failure to Complete Work On Time*, or may make other charges in accordance with the contract. These charges will be assessed using the contract pay items in this section.

**696-4 METHOD OF MEASUREMENT.** These contract pay items will not be shown in the itemized proposal. Contractor charges will be measured on a Dollars-Cents basis.

**696-5 BASIS OF PAYMENT.** Should the Contractor be assessed charges, the amounts will be accounted for using the contract pay items in this section. Assessed charges will be deducted from a contract payment processed after the determination that charges will be made, or, if the Contractor is not due monies sufficient to recover the assessed charges, the State may utilize other methods of recovery.

*Payment will be made under:*

Item No.	Item	Pay Unit
696.01	Engineering Charges	Dollars Cents
696.02	Liquidated Damages	Dollars Cents
696.03	Contractor Charges – Other	Dollars Cents

## SECTION 697 - FIELD CHANGE PAYMENT

(Last Revised January, 2020)

### 697-1 DESCRIPTION

**697-1.01 General.** The Field Change Payment (FCP) provides a contract contingency allowance for the timely payment of authorized extra work that was completed to fulfill the intent of the contract documents.

**697-1.02 Eligible Work.** Only the following extra work will be eligible for FCP item payments:

1. Work within the scope of the contract.
2. Completed additional quantities of existing contract items of work processed as unit bid prices:
  - Up to 200% of original contract quantity for Minor Items of work.
  - More than 200% of a Minor Item original contract quantity that results in an increase less than \$5,000.00 from the original contract amount.
  - Up to 125% of original contract quantity for Major Items of work.
3. Completed additional quantities of existing contract items that have exceeded the threshold quantities, but have unit bid prices that are acceptable by comparison to the Weighted Average Awarded Prices or the Average of the Three Lowest Bidders.
4. Completed additional quantities of existing contract items that have exceeded the threshold quantities, which requires the use of new item numbers, and renegotiated prices that are acceptable by comparison to the Weighted Average Awarded Prices or the Average of the Three Lowest Bidders.
5. Completed quantities of new contract items of work with Agreed Prices that are acceptable by comparison to the Weighted Average Awarded Prices.
6. Fuel, Asphalt, or Steel Adjustment items calculated for eligible work completed.

**697-2 MATERIALS.** None specified.

**697-3 CONSTRUCTION DETAILS.** None specified.

**697-4 METHOD OF MEASUREMENT.** The unit price shown in the proposal for this item will be considered as the unit price bid and shall not be altered in any manner. Should the amount shown be altered, the figure entered will be disregarded and the original unit price will be used to determine the total amount bid for the contract.

**697-5 BASIS OF PAYMENT.** All work to be paid under the FCP item must receive prior authorization in conformance with §104-02 Changes, Contingencies, Extra Work and Deductions. Disputed work, force account work, work associated with §104-10 Value Engineering Change Proposals, or payments for time-related provisions are not eligible for FCP item payment.

FCP item payments will be determined from the quantities and unit prices of eligible work that have been completed. Work for which FCP item payments are processed will be paid in accordance with the specifications governing the work.

Prior to processing the final agreement, the FCP item payments will be reconciled through an Order-on-Contract, such that the amount of FCP item payments is converted to the corresponding quantities of the pertinent contract pay items. When the amount of FCP item payments is transferred to the appropriate items, the remaining amount of FCP funds will be deleted.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
697.03	Field Change Payment (FCP)	Dollars-Cents

## **SECTION 698 - PRICE ADJUSTMENTS**

(Last Revised September, 2021)

**698-1 DESCRIPTION.** This section will provide for additional compensation to the Contractor for increases, or repayment by the Contractor for decreases, in the price of asphalt, fuel, or steel/iron products.

**698-1.01 Asphalt Price Adjustment.** This item will enable the Department to make price adjustments to account for changes in asphalt prices. Price adjustments will be made for eligible work listed in the contract proposal.

**698-1.02 Fuel Price Adjustment.** This item will enable the Department to make price adjustments to account for changes in fuel prices. Price adjustments will be made for eligible work listed in the contract proposal.

**698-1.03 Steel/Iron Price Adjustment.** This item will enable the Department to make price adjustments to account for changes in steel/iron product prices for materials eligible and identified by the Contractor which will be permanently incorporated into the work.

**698-2 MATERIALS.** None specified.

**698-3 CONSTRUCTION DETAILS.** No adjustment will be provided for any new or additional work paid for by force account. Additional quantities of existing contract pay items at original bid prices will be considered eligible work. Additional work added by agreed price will be considered eligible work. Work performed by the Contractor at its own expense will not be eligible for price adjustment.

The monthly average asphalt prices, monthly average fuel prices, steel cost basis and steel index values will be posted in the Engineering Bulletin entitled *Fuel, Asphalt and Steel Price Adjustments*.

If eligible items are installed after the contract completion date, when an extension of time without the assessment of engineering charges and/or liquidated damages is approved, the monthly average posted price or monthly steel index value will be used to compute price adjustments.

If eligible items are installed after the contract completion date, when an extension of time was approved with the assessment of engineering charges and/or liquidated damages, the monthly average posted price or monthly steel index in effect on the last contract completion date without the assessment of engineering charges and/or liquidated damages, or the value for the month of installation/purchase, whichever is less, will be used to compute price adjustments.

**698-3.01 Asphalt Price Adjustment.** The asphalt price adjustment will be based solely on the price changes for asphalt as determined by the formulas below. No adjustment will be made if the monthly average posted price is within \$15.00 of the asphalt index price. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price.

**A. Prices.** The asphalt index price and the monthly average posted price are defined as follows:

**1. Asphalt Index Price.** The asphalt index price is a price per ton of Performance Graded Binder (PGB) used solely as a basis from which to compute asphalt price adjustments. The asphalt index price for original contract bid price items and additional work at the original contract bid price will be the monthly average posted price for the month of the bid letting. The asphalt index price for additional work at agreed price will be the monthly average posted price for the month the agreed price was submitted to the Engineer.

**2. Monthly Average Posted Price.** The average terminal price for unmodified PG 64S-22 binder, without anti-stripping agent, determined by the Department, based on prices of approved primary sources of PGB.



**B. Quantity.** The quantity of asphalt in tons considered for adjustment will be determined by multiplying the quantity of eligible work completed by the conversion factors listed in the Special Note entitled *Asphalt Price Adjustment*.

**C. Adjustment.** Asphalt price adjustment will be based on the following formulas:

**1. When price increases:** Price Adjustment = (Quantity of Asphalt) x (Monthly Average Posted Price - PGB Index Price - \$15.00)

**2. When price decreases:** Price Adjustment = (Quantity of Asphalt) x (Monthly Average Posted Price - PGB Index Price + \$15.00)

**698-3.02 Fuel Price Adjustment.** The fuel price adjustment will be based solely on the price changes for fuel as determined by the formulas below. No adjustment will be made if the monthly average posted price is within \$0.10 per gallon of the fuel index price. No consideration will be given to the situation where an individual supplier's price exceeds the monthly average posted price,

**A. Prices.** The fuel index price and the monthly average posted price are defined as follows:

**1. Fuel Index Price.** A price per gallon of fuel used solely as a basis from which to compute fuel price adjustments. The fuel index price for original contract bid price items and additional work at the original contract bid price will be the monthly average posted price for the month of the bid letting. The fuel index price for additional work at agreed price will be the monthly average posted price for the month the agreed price was submitted to the Engineer.

**2. Monthly Average Posted Price.** An average refinery or terminal price based on prices for ultra low sulfur diesel (ULSD) and gasoline.

**B. Quantity.** The quantity of fuel in gallons considered for adjustment will be determined by multiplying the quantity of eligible work completed by the fuel usage factor listed in the Special Note entitled *Fuel Price Adjustment*.

**C. Adjustment.** Fuel price adjustment will be based on the following formulas:

**1. When price increases:** Price Adjustment = (Quantity of Fuel) x (Monthly Average Posted Price - Fuel Index Price - \$0.10)

**2. When price decreases:** Price Adjustment = (Quantity of Fuel) x (Monthly Average Posted Price - Fuel Index Price + \$0.10)

**698-3.03 Steel/Iron Price Adjustment.** Within 30 calendar days after award, the Contractor shall provide the Engineer with a list of materials to which the Contractor opts to apply the steel price adjustment, identifying the materials by groups of similar material content within a core (3 digit) contract pay item (e.g. 564 *Structural Steel* or 603.05xxxx *Corrugated Steel Pipe*). For each material listed, the Contractor shall also identify the parties whose relationship establishes the invoice date. If the two parties are known, they shall be identified by name. If the two parties are not known, they shall be identified by role (Contractor, Subcontractor, Material Supplier, Fabricator, Manufacturer, Mill, etc.). Different parties may be identified for individual or groups of contract pay items for the purposes of establishing an invoice date. If the Contractor does not provide a list of materials to which to apply the steel price adjustment, no steel price adjustment will be made.

If the percentage change for a given month does not exceed 5% plus or minus, from the benchmark steel index, no adjustments will be made for materials invoiced that month. For lump sum or each items that are assembled from numerous components, such as overhead sign structures, the percentage change will be determined for the assembled contract pay item using the month that the largest value of materials were invoiced. For unit price items such as guiderail that are assembled from numerous components, the percentage change will be determined for a given quantity of the contract pay item using the month that the largest value of component materials for that quantity of the contract pay item were invoiced.

The weight of the steel and/or iron shall exclude minor appurtenances individually weighing less than 5 lbs (i.e., nuts, bolts, washers, etc.). Precast or prestressed concrete items shall have total reinforcing steel weight listed on the approved shop drawings. The following sources shall be used, in declining order of precedence, to determine the weight of steel/iron: Department established weights of steel/iron by contract pay item per pay unit; approved shop drawings; verified shipping documents; contract documents; Standard Sheets; industry standards (i.e., AISC Manual of Steel Construction, AWWA Standards, etc.); and manufacturer's data.

**A. Indexes and Prices.** Adjustments are based on the Producer Price Index (PPI) for *Semifinished Steel Mill Products* (WPU 101702). PPI values are published by the US Department of Labor, Bureau of Labor Statistics (BLS). Recent PPI values are posted on the Office of Construction website at [www.dot.ny.gov](http://www.dot.ny.gov). A complete listing of PPI values can be found on the BLS website at <http://data.bls.gov/PDQ/outside.jsp?survey=wp>. The Cost Basis, Benchmark Steel Index, Monthly Steel Index, and the Percentage Change are defined as follows:

**1. Cost Basis (CB).** An average price of steel products in dollars per ton used solely as a cost basis from which to compute steel/iron price adjustments. The cost basis for original contract bid price items and additional work at the original contract bid price will be the cost basis listed for the month of the bid letting. The cost basis for additional work at agreed price will be the value of the cost basis for the month the agreed price was submitted to the Engineer.

**2. Benchmark Steel Index (BI).** The benchmark steel index for original contract bid price items and additional work at the original contract bid price will be the value of the preliminary PPI for the month of the bid letting. The benchmark steel index for additional work at agreed price will be the value of the preliminary PPI for the month the agreed price was submitted to the Engineer.

**3. Monthly Steel Index (MI).** Value of the final PPI for the month the material is invoiced. If the final PPI is not posted for a given month, the value will be the preliminary PPI for the month the material is invoiced. If a preliminary PPI is not posted for a given month, the value will be the average of the two preceding months that are posted.

**4. Percent Change.** The percent change in any given month will be determined as follows:

$$\text{Percentage Change} = \left( \frac{MI - BI}{BI} \right) \times 100$$

**B. Quantity.** The quantity of steel and/or iron for adjustment for each core (3-digit) contract pay item number (e.g., 564 – *Structural Steel*) will be measured to the nearest 0.1 Tons.

**1. Percent Change Greater Than +5%.** If the Percentage Change is greater than +5% from the benchmark steel index, Price Adjustments will be made for materials invoiced that month. The Contractor shall provide the Engineer a detailed list of the weight of eligible materials within 60 calendar days after installation, including: the contract pay item, the weight of steel/iron, the

month(s) of invoice, the source used to determine the weight, and if requested by the Engineer, copies of invoices to verify the month of invoice.

**2. Percent Change -5% to +5%.** If the Percentage Change is between -5% and +5%, inclusive, from the benchmark steel index, no adjustments will be made for materials invoiced that month.

**3. Percent Change Lower Than -5%.** If the Percentage Change is lower than -5% from the benchmark steel index, a Price Adjustment will be charged to the Contractor for materials invoiced that month. The Contractor shall provide the Engineer a detailed list of the weight of eligible materials within 60 calendar days after installation, including: the contract pay item, the weight of steel/iron, the month(s) of invoice, the source used to determine the weight, and copies of invoices to verify the month of invoice.

**C. Adjustment.** Steel/Iron price adjustment will be made for the materials which the Contractor opted to apply the steel price adjustment, based on the following formulas:

1. When price increases:

$$\text{Price Adjustment} = \left[ \left( \frac{MI - BI}{BI} \right) - 0.05 \right] (CB) Qty$$

2. When price decreases:

$$\text{Price Adjustment} = - \left[ \left( \frac{MI - BI}{BI} \right) + 0.05 \right] (CB) Qty$$

**698-4 METHOD OF MEASUREMENT. 698-4.01 Asphalt Price Adjustment.** Asphalt price adjustments will be measured on a Dollar Cents basis.

**698-4.02 Fuel Price Adjustment.** Fuel price adjustments will be measured on a Dollar Cents basis.

**698-4.03 Steel/Iron Price Adjustment.** Steel/Iron price adjustments will be measured on a Dollar Cents basis.

**698-5 BASIS OF PAYMENT.** The unit price shown in the itemized proposal will be considered the unit price bid, although actual payment will be calculated based on changes in posted material prices. Should the amount shown be altered, the altered figures will be disregarded and the original price will be used to determine the total contract bid amount.

If price adjustments are based on estimated material quantities, and a revision to the estimated material quantity is made in a subsequent or final estimate, an appropriate addition or deduction will be made to the price adjustment previously calculated. The addition or deduction will be based on the adjustment factors initially used to calculate the price adjustment. If the installation dates of the revised material quantity cannot be determined, the addition or deduction will be based on the adjustment factors in effect during the last month in which any portion of the material quantity was installed.

**698-5.01 Asphalt Price Adjustment.** The asphalt price adjustment will be based on the monthly average posted price in effect at the time the work is completed, calculated using the price adjustment formula described above.

**698-5.02 Fuel Price Adjustment.** The fuel price adjustment will be based on the monthly average posted price in effect at the time the work is completed, calculated using the price adjustment formula described above.

**698-5.03 Steel/Iron Price Adjustment.** The steel/iron price adjustment will be based on the monthly steel index in effect at the time of invoice between the two parties previously identified by the Contractor, calculated using the price adjustment formula described above.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
698.04	Asphalt Price Adjustment	Dollars Cents
698.05	Fuel Price Adjustment	Dollars Cents
698.06	Steel/Iron Price Adjustment	Dollars Cents

## **SECTION 699 - MOBILIZATION**

**699-1 DESCRIPTION.** Under this work the Contractor shall provide necessary bonds, insurance, and prefinancing and shall set up his necessary general plant, including shops, storage areas, office and such sanitary and other facilities as are required by local or state law or regulation.

**699-2 MATERIALS.** Such materials as required for mobilization and that are not to be part of the completed contract shall be as determined by the Contractor, except that they shall conform to any pertinent local or State Law, regulation or code.

**699-3 CONSTRUCTION DETAILS.** The work required to provide the above facilities and service for mobilization shall be done in a safe and workmanlike manner and shall conform with any pertinent local or State Law, regulation or code. Good housekeeping consistent with safety shall be maintained.

**699-4 METHOD OF MEASUREMENT.** Payment for mobilization will be made on a lump sum basis.

**699-5 BASIS OF PAYMENT.** The amount bid for mobilization shall not exceed four percent (4%) of the total contract bid price excluding the bid price for mobilization. Should the bidder exceed the foregoing four percent (4%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

The amount bid shall include the furnishing and maintaining of services and facilities noted under §699-1 DESCRIPTION, to the extent and at the time the Contractor deems them necessary for his operations, consistent with the requirements of this work and the respective contract.

The amount bid shall be payable to the Contractor with the first contract payment made for other contract work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
699.040001	Mobilization	Lump Sum



**Department of  
Transportation**

# **STANDARD SPECIFICATIONS**

(US CUSTOMARY UNITS)

**VOLUME 4  
SECTION 700**

**CONSTRUCTION  
AND  
MATERIALS**

**May 1, 2022**

50 Wolf Road  
Albany, New York 12232

[www.dot.ny.gov](http://www.dot.ny.gov)

## **INTRODUCTION**

This publication has been prepared to provide a compilation of standard requirements, called Specifications, used by the New York State Department of Transportation for construction contracts. These specifications are written to the Contractor. They define the Contractor's responsibility in meeting each specification, enumerate the Department's expectations and how they are going to measure and pay, and explain what the Contractor is expected to provide.

When this publication, entitled Standard Specifications (USC) and dated as shown on the Title Page, is incorporated by reference into the Department's construction contracts, it is made a part of that contract. The requirements stated herein may be revised or amended from time to time by notes or special specifications or documents of any description that would be furnished as part of a construction contract.

# STATE OF NEW YORK

## DEPARTMENT OF TRANSPORTATION

### ENGINEERING DIVISION

Contained herein are:

General Provisions of Contract;

Contract forms of Proposal, Agreement and Bonds;

General Construction Specifications;

Materials of Construction;

Payment Items

Adopted

by

The Commissioner of Transportation

and Short Titled

## **"STANDARD SPECIFICATIONS" (USC)**

*Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.*

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# Section 700

## MATERIALS and MANUFACTURING

### SECTION 701 - HYDRAULIC CEMENTS

#### 701-01 PORTLAND CEMENT

**SCOPE.** This specification covers non-air entrained cements defined by AASHTO M 85.

For uniformity with recognized industry terminology, Types I, II, II(MH) III, IV, V and VI may also be designated as Types 1, 2, 2(MH), 3, 4, 5 and 6 respectively. Any cement designated with a combined classification, such as Type I/II, must meet the requirements of both types being offered. The type of cement to be used will be as shown in the plans or specifications for each contract. When specified in the contract documents, Type VI cement shall meet the requirements of AASHTO M 85-Type I cement, and the cement color shall be white.

**MATERIAL REQUIREMENTS.** All types of cement shall conform to the chemical and physical requirements of those respective types as contained in AASHTO M 85 with the following:

Any cement possessing equivalent alkali contents ( $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ ) in excess of 0.70% will be considered “high alkali” cement, and will be restricted for use as per the requirements of Section 501. The Department reserves the right to impose the “Optional Chemical and Physical Requirements” of AASHTO M 85 such as *Equivalent Alkalies* (AASHTO T-105) and *False Set* (AASHTO T-186). The temperature of the cement, measured immediately prior to entering the mixing unit at a batching facility, shall not exceed 170°F.

**MANUFACTURER.** The manufacturer shall declare the commercial name of the additions used and the amount thereof in writing to the Materials Bureau.

**STORAGE.** The cement shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau. All silos shall be completely empty and clean before cement is deposited therein unless the silo contains Department approved cement of the same type.

Cement remaining in bulk storage at the mill and/or distribution terminal for a period greater than one year after completion of tests shall be re-sampled and retested before shipment. However, cement which has been in bulk storage at mills and/or distribution terminals more than two years from the time of original manufacture shall not be used. No cement stored by the Contractor over the winter shall be used until retested by the Materials Bureau. Bagged cement shall not be stored at mill or terminal locations for a period longer 2 calendar years from the date of manufacture when preparing an order for shipment.

**SHIPMENT.** All shipments of cement shall be made in accordance with Materials Method (MM) 10 or other procedural directives issued by the Materials Bureau. Conveyances for bulk cement shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any cement is loaded therein. Cement may be shipped in paper bags which

conform to industry standards which have the manufacturer's brand name, type of cement, and the date of manufacture clearly printed on the outside of the package.

**INSPECTION AND TESTING.** All inspection and testing shall be in accordance with MM 10 or other procedural directives issued by the Materials Bureau. When required by the Materials Bureau, cement shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of cement and deliver such samples into a sealed container approved by the Materials Bureau. Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 85.

**BASIS OF ACCEPTANCE.** Portland cement will be considered for acceptance at mill or terminal locations in accordance with MM 10 or other procedural directives issued by the Materials Bureau.

### **701-02 MASONRY AND MORTAR CEMENT**

**SCOPE.** Masonry and mortar cement, used to make masonry mortar.

#### **MATERIALS**

Masonry Cement	ASTM C91
Mortar Cement	ASTM C1329

**BASIS OF ACCEPTANCE.** The Engineer will base acceptance on each package being labeled to show ASTM conformance and its contents being in good condition.

### **701-03 BLENDED PORTLAND CEMENT**

**SCOPE.** This specification covers non-air entrained Blended Portland cement for use in Portland cement concrete using Portland cement, Fly ash, Ground Granulated Blast Furnace Slag (GGBFS), Microsilica (Silica Fume), High Reactivity Pozzolan (HRP) or Limestone.

**GENERAL.** Blended Portland cements shall meet the chemical and physical requirements of AASHTO M 240, unless otherwise noted herein, or as modified in the project plans or specifications. The composition of the blended cement, including the percent of each constituent, shall be clearly stated on the product certification. Any blended cement proposed for use shall be appropriately proportioned with the desired constituents to meet the applicable cementitious requirements of the specified concrete mix design.

**Portland-Pozzolan Cement, TYPE IP.** A product meeting the requirements of AASHTO M 240 Type IP where the pozzolan portion of the blend is comprised of *Fly Ash* (§711-10) meeting AASHTO M 295, *Microsilica* (§711-11) meeting AASHTO M 307, or *HRP* (§711-14) meeting AASHTO M 321. Typical Type IP blended cements specified for use are:

**TYPE IP (21).** Whereas the pozzolan portion of the blended product is comprised of 21% (by weight) of either of the following: *Class C, F or N Pozzolan* meeting the requirements of AASHTO M 295.

**TYPE IP (8).** Whereas the pozzolan portion of the blended product is comprised of 8% (by weight) of either of the following: *Microsilica* (§711-11), or *HRP* (§711-14).

**Portland-Blast Furnace Slag Cement, TYPE IS.** A product meeting the requirements of AASHTO M 240 Type IS, where the pozzolan portion of the blend is comprised of *Ground Granulated Blast*

*Furnace Slag* (GGBFS) meeting the requirements of AASHTO M 302 (§711-12). The amount of GGBFS is limited to 25% of the total weight of blended product.

**Portland-Limestone Cement, TYPE IL.** A product meeting the requirements of AASHTO M 240 Type IL, where the Portland cement is blended with *Limestone* meeting the requirements of AASHTO M 240.

**Ternary Blend Cement, TYPE IT.** A product meeting the requirements of AASHTO M 240 Type IT, where Portland cement is blended with two pozzolans or blended with a combination of pozzolan and Limestone. Such blends may consist of a combination of Portland-Blast Furnace Slag cement, (meeting the requirements of AASHTO M 240 Type IS), and a third pozzolan, meeting the requirements of either; *Fly Ash* (§711-10), *Microsilica* (§711-11), *HRP* (§711-14) or *Limestone* (AASHTO M 240).

**MATERIAL REQUIREMENTS.** The individual constituents shall meet the following:

Portland Cement	701-01 <i>Type II</i> or <i>Type II (MH)</i> only
Fly Ash	711-10
Microsilica (Silica Fume)	711-11
Ground Granulated Blast Furnace Slag	711-12
High Reactivity Pozzolan (HRP)	711-14
Limestone	AASHTO M 240

The manufacturer shall supply supporting documentation as noted in AASHTO M 240. Blended cement possessing equivalent alkali contents ( $\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$ ) in excess of 0.70% will be considered “high alkali” cement, and will be restricted for use as per the requirements of § 501. The blended cement shall remain uniform throughout the blending, shipping and storage process until it is incorporated into the concrete mixture.

**STORAGE.** The blended cement shall be stored at its source of supply in approved weather-tight silos. Provisions for maintaining the designated silos under Department seal control will be required when directed by the Materials Bureau. All silos shall be completely empty and clean before blended cement is deposited therein unless the silo contains Department approved blended cement of the same type. Blended cement remaining in bulk storage at the mill, blending facility and/or distribution terminal for a period greater than one year after completion of laboratory testing must be re-sampled and tested before shipment. Blended cement that has been in storage at the mill, blending facility or distribution terminal for a period of two years from the original date of cement manufacture may not be used. Blended cement that has been stored by the supplier or batching facility over the winter must be tested by the Materials Bureau. Bagged blended cements shall not be stored at mill or terminal locations for a period longer than two calendar years from the date of blending when preparing an order for shipment.

**SHIPMENT.** All shipments of blended cements shall be in accordance with Materials Method (MM) 10 or other procedural directives issued by the Materials Bureau. Conveyances for bulk shipment must be of a type approved by the Department. The compartments of all such conveyances must be completely empty and clean before any blended cement is loaded therein. Blended cement may be shipped in paper bags which conform to industry standards which have the manufacturer’s brand name, type of cement, and the date of manufacture plainly printed on the outside of the package.

**INSPECTION AND TESTING.** All inspection and testing shall be in accordance with MM 10 or other procedural directives issued by the Materials Bureau. When required by the Materials Bureau, blended cement shall be sampled by means of an automatic sampling device, constructed to obtain continuous

samples across the full stream of blended cement, and deliver such samples into a sealed container approved by the Materials Bureau. Testing of chemical and physical properties shall be in accordance with the methods referenced in the appropriate AASHTO standards. Samples which are obtained for Department testing shall be retained for a period of one calendar year after the date of completion of testing.

**BASIS OF ACCEPTANCE.** Blended cement will be considered for acceptance at mill or terminal locations in accordance with MM 10 or other procedural directives issued by the Department.

**701-04 CONCRETE REPAIR MATERIAL**

**SCOPE.** The material covered in this specification is generally used for shallow repairs of portland cement concrete, including repair of precast concrete products, such as pipe, cribbing, manholes, etc...

**GENERAL.** The use of this material is limited to repair areas smaller than 5 ft<sup>2</sup> and not deeper than 2 in. This material is meant to be applied and finished with a trowel in a horizontal position. The Department will test the material in accordance with Test Method NY 701-13P,C following the manufacturer's proportioning and mixing instructions printed on the package. Material meeting the requirements of this specification will be placed on the Approved List. For field use, follow the manufacturers mixing and curing recommendations.

**MATERIAL REQUIREMENTS.** The material shall be a prepackaged dry component: to which water or emulsified compound is added, used for concrete repair, containing no metallic expansion aides, to which no aggregate may be added, meeting the requirements of Table 701-04. When being used for aesthetic purposes the material's color shall be within the Munsell Neutral Scale range stated in Table 701-04.

<b>TABLE 701-04 CONCRETE REPAIR MATERIAL</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	10	60
Expansion (%)	-	0.4
Contraction (%)	-	0.0
1 Day Compressive Strength (psi)	3000	-
7 Day Compressive Strength (psi)	5000	-
28 Day Compressive Strength (psi)	6000	-
1 Day Bond Strength (psi)	200	-
Freeze/Thaw Loss % (25 cycles)	-	1.0
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0
Color, Munsell Neutral Scale	4.0	8.5

**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the

product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-13P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

**701-05 CONCRETE GROUTING AND ANCHORING MATERIAL**

**SCOPE.** This specification covers the requirements for grouting material used to grout anchor bolts, dowels and other items in portland cement concrete. This material can also be used for forming mortar pads under bridge rail supports.

**GENERAL.** This material should not be used in layers thicker than 2 in. The Department will test the material according to Test Method NY 701-11P,C following the manufacturer's proportioning and mixing instructions printed on the package. Material meeting the requirements of this specification will be placed on the Approved List. For field use, follow the manufacturers mixing and curing recommendations.

**MATERIAL REQUIREMENTS.** The material shall be a prepackaged, dry component: to which water or emulsified compound is added, used for concrete repair, containing no metallic expansion aides, to which no aggregate may be added, meeting the requirements of Table 701-05.

<b>TABLE 701-05 CONCRETE GROUTING AND ANCHORING MATERIAL</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	30	-
Expansion (%)	-	0.4
Contraction (%)	-	0.0
1 Day Compressive Strength (psi)	3000	-
7 Day Compressive Strength (psi)	6000	-
Pullout Strength (lbs)	10000	-
Freeze-Thaw Loss % (25 cycles)	-	1.0
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0



**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-11P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

**701-06 SHEAR KEY GROUT**

**SCOPE.** This specification covers the requirements for grout to be placed in shear keys between precast concrete structural units.

**GENERAL.** The material must be flowable to fill the shear key with no voids. The Department will test the material in accordance with Test Method NY 701-12P,C following the manufacturer's proportioning and mixing instructions printed on the package. Material meeting the requirements of this specification will be placed on the Approved List. The Approved List titled: Shear Key Grout will state the precise water-grout ratio by weight. This ratio shall not be altered. For field use, follow the manufacturers mixing and curing recommendations.

**MATERIAL REQUIREMENTS.** The material shall be a prepackaged dry component: to which water or emulsified compound is added, used for concrete repair, containing no metallic expansion aides, to which no aggregate may be added. The material must meet the shear key pourability test as per Test Method NY 701-12P,C and the requirements of Table 701-06.

<b>TABLE 701-06 SHEAR KEY GROUT</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	120	-
Expansion (%)	0.02	1.0
Contraction (%)	-	0.0
7 Day Compressive Strength (psi)	6000	-
Freeze-Thaw Loss % (25 cycles)	-	1.0
Total Chloride Content (% by weight)	-	0.05

Total Sulfate Content (% by weight)	-	5.0
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**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-12P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

#### 701-07 ANCHORING MATERIALS - CHEMICALLY CURING

**SCOPE.** This specification applies to chemically curing polymer anchoring materials used for installing steel elements such as threaded rods, deformed reinforcing bars and internally threaded steel sleeves with external deformations into concrete.

**GENERAL.** The material must be suitable for use in outdoor conditions and shall be a non-metallic, non-shrink polymer resin supplied in prepackaged and/or premeasured containers. It shall contain no rust or corrosion promoting agents and shall be moisture insensitive. For purposes of this specification, "manufacturer/supplier" is defined as "the entity whose brand name is listed on the adhesive container" and the term "unexpired" as it relates to the evaluation report, is defined as "currently valid, as determined by the authoring evaluation service".

**MATERIAL REQUIREMENTS.** Chemically curing anchoring materials shall meet the following material requirements:

- 1. Evaluation Report:** Manufacturer/supplier shall submit to the Materials Bureau an unexpired evaluation report published by an evaluation service that is accredited per ISO/IEC 17065 and approved by the Materials Bureau. The report shall demonstrate that the adhesive anchor system qualifies to the current edition of ACI 355.4 for cracked and uncracked concrete. An approved product whose evaluation report is no longer considered valid by the evaluation service will be subject to removal from the Approved List.
- 2. Chemical Resistance.** Cured adhesive shall be resistant to most chemicals and solvents. The manufacturer/supplier shall submit to the Materials Bureau a test report from an independent testing agency accredited to ISO/IEC17025, certifying that the adhesive meets the requirements set forth in the table below. The testing shall expose adhesive specimens to a 2000-hour immersion in solutions of the listed de-icing salts per current ACI 355.4 for *Durability Assessment*.

The ratio between the mean bond stress of the slices stored in the respective de-icing salts,  $\bar{\tau}_{\text{Salt}}$  and mean bond stress of the unexposed reference slices,  $\bar{\tau}_{\text{Ref}}$  shall not be less than the specified value below.

<b>CHEMICAL RESISTANCE REQUIREMENT</b>	
<b>Chemical</b>	$\bar{\tau}_{\text{Salt}} / \bar{\tau}_{\text{Ref}}$
Sodium Chloride (23%)	0.9
Calcium Chloride (30%)	0.9
Magnesium Chloride (25%)	0.9

**3. Manufacturer’s Printed Installation Instructions (MPII):** Manufacturer/supplier shall submit to the Materials Bureau a copy of the MPII as supplied in the packaging for the adhesive anchor system. The MPII shall comply with the requirements established in the current edition of ACI 355.4 and contain all the necessary instructions to install the adhesive anchor system correctly, including (but not limited to): gel/cure time, threaded rod/rebar sizes with corresponding drill-bit diameters, min/max embedment, storage information and applicable installation procedures (drilling, cleaning, adhesive material conditioning etc.). Changes to the MPII must be reported to the Materials Bureau. Any changes to the MPII of an Approved List product that results in the MPII no longer meeting the requirements of this specification may result in removal of the product from the Approved List.

**BASIS OF APPROVAL.** Application for approval of Anchoring Materials - Chemically Curing shall be made by the manufacturer or supplier to the Materials Bureau and shall include the following:

- A copy of an unexpired evaluation report showing qualification per current edition of ACI 355.4.
- Independent test data (chemical resistance test results).
- Manufacturer’s Printed Installation Instructions (MPII) as supplied in the packaging.
- Safety Data Sheet.
- Product Label.

Once the submitted materials are reviewed and deemed acceptable by the Department’s Materials Bureau the applicant shall supply six 5/8-inch diameter fully threaded steel rods, 10 inches long having a minimum tensile strength of 120 ksi along with sufficient adhesive material for testing by the Materials Bureau. A manufacturer’s or supplier’s representative shall be present to perform the installation of the adhesive anchors. The Department’s Materials Bureau shall perform tensile pullout testing on the 5/8-inch diameter rods embedded 4 inches deep in unreinforced concrete. Two sets of three tests (wet/dry) shall be performed in accordance with Test Method NY 701-14E, and each test shall meet the minimum required load. The minimum required pullout values for various concrete strengths are shown below:

<b>MINIMUM REQUIRED PULLOUT LOAD FOR 4 INCH EMBEDMENT DEPTH</b>				
Concrete Compressive Strength (psi)	4000	4500	5000	5500
Minimum Pullout Load (lb.)	12,042	12,772	13,463	14,120

Upon test performance that meets or exceeds the requirements specified above, the Materials Bureau shall approve the product for use. After such approval, the name of the product and its manufacturer/supplier shall appear on the Approved List.

**BASIS OF ACCEPTANCE.** Products proposed for use shall be accepted on the basis of the brand and product name appearing on the Approved List, the brand and product name clearly printed on the sealed, non-reusable, unexpired container bearing the expiration-date of the material and a Material Certification stating that the material (1) is the same as that appearing on the Approved List and (2) meets these specifications.

**701-08 VERTICAL AND OVERHEAD REPAIR MATERIAL**

**SCOPE.** This specification covers the requirements for Vertical and Overhead Repair Material for placement in structural concrete repairs.

**GENERAL.** The use of this material is limited to repair areas smaller than 4 ft<sup>2</sup> and not deeper than 2 in, and is meant to be applied and finished with a trowel. The Materials Bureau will consider other application techniques on a case by case basis. The Department will test the material in accordance with Test Method NY 701-17P,C following the manufacturer's proportioning and mixing instructions printed on the package. Material meeting the requirements of this specification will be placed on the Approved List. For field use, follow the manufacturers mixing and curing recommendations.

**MATERIAL REQUIREMENTS.** The material shall be a prepackaged dry component: to which water or emulsified compound is added, used for concrete repair, containing no metallic expansion aides, to which no aggregate may be added. The material shall be able to be placed in layers of at least 1 inch on overhead applications without the use of formwork or anchoring devices. When being used for aesthetic purposes the material’s color shall be within the Munsell Neutral Scale range stated in Table 701-08.

<b>TABLE 701-08 VERTICAL AND OVERHEAD REPAIR MATERIAL</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	15	-
Expansion (%)	-	0.4
Contraction (%)	-	0.0
7 Day Compressive Strength (psi)	4000	-
28 Day Compressive Strength (psi)	5000	
1 Day Bond Strength (psi)	200	-
Freeze-Thaw Loss % (25 cycles)	-	1.0
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0
Color, Munsell Neutral Scale	4.0	8.5

**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-17P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the

formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

**701-09 CONCRETE REPAIR MATERIAL - RAPID HARDENING**

**SCOPE.** This specification covers the requirements for material to repair portland cement concrete where rapid strength gain is required.

**GENERAL.** Its use is limited to areas no larger than 10 ft<sup>2</sup> or 5 ft<sup>3</sup> in volume for a single patch. This material is intended for partial or full depth repairs. This material may be extended with dried Department approved CA1 coarse aggregate. This product must provide the ability to accept traffic loads within 1 hour of placement. The Department will test the material neat except where noted in Table 701-09 to test neat and extended according to Test Method NY 701-21P,C following the manufacturer's proportioning and mixing instructions printed on the package. Material meeting the requirements of this specification when tested (Neat and Extended), will be placed on the Approved List.

**MATERIAL REQUIREMENTS.** This material shall be a prepackaged, multi-component powdered material, containing no metallic expansion aides, and must remain workable when a minimum of 60% extended by weight with Department approved CA1 coarse aggregate and meets the requirements of Table 701-09. When being used for aesthetic purposes the material's color shall be within the Munsell Neutral Scale range stated in Table 701-09.

<b>TABLE 701-09 CONCRETE REPAIR MATERIAL - RAPID HARDENING</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	5	-
Expansion (%)	-	0.4
Contraction (%)	-	0.0
1 Hour Compressive Strength (psi)	2000	-
3 Hour Compressive Strength (psi) **	3000	-
7 Day Compressive Strength (psi)	6000	-
1 Day Bond Strength (psi)	200	-
Freeze-Thaw Loss % (25 cycles)**	-	1.0
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0

Color, Munsell Neutral Scale	4.0	8.5
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\*\* Neat and Extended

**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-21P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

#### 701-10 DUCT GROUTING MATERIAL (STRUCTURES)

**SCOPE.** Requirements for grout used to fill the post-tensioning ducts in concrete bridge elements.

**GENERAL.** For field use, follow the manufacturer's mixing and curing recommendations. Material meeting the requirements of this specification when tested will be placed on the Approved List.

**MATERIAL REQUIREMENTS.** Prepackaged, cementitious material containing no metallic expansion aides that, when mixed with water at manufacturer's stated water/cement material ratio ( $w/c \leq 0.40$ ), and meets the requirements of Table 701-10. The Department will test the material according to NYSDOT Test Method 701-18 P,C, following the manufacturer's proportioning and mixing instructions printed on the package.

<b>TABLE 701-10 DUCT GROUTING MATERIAL (STRUCTURES)</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (hours)	1½	12
Expansion (%)	0.0	0.40
Contraction (%)	-	0.0
24 Hour Compressive Strength (psi)	2000	-
7 Day Compressive Strength (psi)	3500	-
28 Day Compressive Strength (psi)	5000	-

Bleed Water (%)	-	0.0
Permeability (coulombs)	-	2000
Fluidity efflux time, seconds	11	30
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0

**THIXOTROPIC GROUTS.** If used, modify the fluidity test as follows:

- A) Fluidity efflux time - 5 to 30 seconds for a 0.264 gallon (34 fl oz.) discharge of grout.
- B) Allow the grout to idle for 30 minutes; then remix it for 30 seconds. Efflux time immediately after remixing  $\leq$  30 seconds.

**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-18P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

### 701-11 ELASTOMERIC CONCRETE

**SCOPE.** This specification covers the material requirements for elastomeric concrete.

**GENERAL.** Supply elastomeric concrete components and primer materials in prepackaged and/or premeasured containers with the product name, manufacturer, VOC content, and mixing instructions clearly marked on each container.

### MATERIAL REQUIREMENTS.

**Physical Test Requirements.** Elastomeric concrete will conform to the following physical test requirements:

TESTS	PROCEDURE	MINIMUM REQUIREMENTS
Resilience	ASTM C579-01	70%
5-Hr. Compressive Strength	ASTM C579-01 (modified)	500 psi

24-Hr. Compressive Strength	ASTM C579-01 (modified)	2000 psi
7-Day Tensile	ASTM D638	150 psi
7- Day Tear	ASTM D624	40 lb <sub>f</sub> /in
Pot Life	Gardco GT-S Gel Timer	5 minutes

**Materials Details.** The manufacturer will submit Material Detail Sheets to the Materials Bureau for approval. Upon approval, the manufacturer, product name, and the Material Detail Number will be placed on the Department’s Approved List.

**Field Evaluation.** To maintain Approved List status, the elastomeric concrete will be evaluated by the Materials Bureau or a designated representative at six-month intervals for a period of two years from the date of installation. If the material is performing as designed at the end of the two-year evaluation approved status will continue.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer’s name appearing on the Department’s Approved List for Materials and Equipment. The supplier shall provide two copies of the Approved Material Detail Sheets and Material Safety Data Sheets through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 14 days prior to shipment of the product to the job site.

**701-12 CONCRETE REPAIR MATERIAL - HIGH EARLY STRENGTH**

**SCOPE.** This specification covers a high early strength repair material, consisting of a dry component made up of cementing medium and fine aggregate to which water or an emulsified compound is added. The resulting mixture is generally used in repair of portland cement concrete pavement.

**GENERAL.** This material is intended for partial or full depth repairs, has the ability to be extended with Department approved CA1 aggregate, and provide at least 30 minutes of working time. This product must provide the ability to accept traffic loads within 3 hours of placement. For field use, follow the manufacturer’s mixing and curing recommendations. Material meeting the requirements of this specification when tested (neat and extended), will be placed on the Approved List.

**MATERIAL REQUIREMENTS.** The material shall be a prepackaged, multi-component powdered material, used for concrete repair, containing no metallic expansion aides. The product must remain workable when extended with up to 60% by weight with coarse aggregate, and meet the requirements of Table 701-12. When being used for aesthetic purposes the material’s color shall be within the Munsell Neutral Scale range stated in Table 701-12.

<b>TABLE 701-12 CONCRETE REPAIR MATERIAL - HIGH EARLY STRENGTH</b>		
<b>TEST REQUIREMENT</b>	<b>Min.</b>	<b>Max.</b>
Initial Set (minutes)	30	-
Expansion (%)	-	0.4
Contraction (%)	-	0.0
3 Hour Compressive Strength (psi) **	2000	-
7 Day Compressive Strength (psi) **	6000	-



1 Day Bond Strength (psi)	200	-
Freeze-Thaw Loss % (25 cycles)	-	1.0
Total Chloride Content (% by weight)	-	0.05
Total Sulfate Content (% by weight)	-	5.0
Color, Munsell Neutral Scale	4.0	8.5

\*\* Neat and Extended

**BASIS OF APPROVAL.** Application for material approval shall be submitted to the Materials Bureau by the manufacturer. The application shall be accompanied by a labeled 50 lb production sample of the product; however the Materials Bureau will approve other packaging quantities on a case-by-case basis. The Department will test the material according to Test Method NY 701-21P,C following the manufacturer's proportioning and mixing instructions printed on the package. Upon approval, the product brand name, manufacturing location and shelf life will be placed on the Approved List. The Department must receive a letter from the manufacturer annually certifying that no changes have been made in the formulation, manufacturing process, or manufacturing location. In the event that a letter is not received, the product may be removed from the Approved List. Furthermore, the material may be removed from the Approved List at any time if the Department is not notified in writing of any material changes as stated above. The Department reserves the right to sample and test the material at any time.

**BASIS OF ACCEPTANCE.** Products will be accepted on the basis of the brand name and manufacturing location appearing on the Approved List. Such products will then be accepted on the basis of the brand name and manufacturing location printed on the sealed, non reusable container along with the month and year (i.e. 05/2011) of when the material was manufactured. The manufacturer is required to print the shelf life on the container if it is less than 12 months. The expiration date of acceptance for this material shall be one calendar year from the date of manufacture or as stated in the Approved List, whichever is less.

### 701-13 RAPID HARDENING HYDRAULIC CEMENT

**SCOPE.** This specification covers the material requirements for *Rapid Hardening Hydraulic Cement* for use in concrete placements where the required accelerated strength cannot be achieved using ordinary Portland Cement mixtures.

**GENERAL.** Supply the *Rapid Hardening Hydraulic Cement* in bulk form as a dry powder. When necessary for testing purposes, or in special placement situations, the product may be supplied in bags or barrels. Any *Rapid Hardening Hydraulic Cement* which contains air entraining or other additives or admixtures will be subject to use limitations as directed by the Materials Bureau.

**MATERIAL REQUIREMENTS.** For approved list consideration, submit documentation showing conformance to ASTM C1600 "*Standard Specification for Rapid Hardening Hydraulic Cement*". The chemical composition and declaration of additives must be furnished when requested by the Department.

**MONITOR SAMPLING.** For monitor sampling of previously approved materials, follow the same procedures as directed in Materials Method 10 for High Reactivity Pozzolans. The Department will monitor the product for conformity with the physical and chemical requirements at its discretion.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall submit one 5 gallon sample of the cement for each manufacturing or

supply location to the Materials Bureau. Provide a Facility Report for each manufacturing or supply location. The report will be required prior to Departments evaluation of the product. Details of the Facility Report outline plan are available by contacting the Materials Bureau. If the material will be manufactured or supplied from multiple locations, submit a separate sample and Facility Report for each location. Submit laboratory test results from a testing laboratory that is accepted by the Cement and Concrete Reference Laboratory (CCRL) indicating conformance to this specification. For each sample submitted for approved list evaluation, provide a certification declaring conformance to this specification, the production lot number, the date of manufacture, the date tested, a manufacturer's label clearly stating the product and manufacturer's name and a Material Safety Data Sheet. The Department will test the submitted sample in accordance with these specifications and Department instructions. Test procedures are available from the Materials Bureau upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved List. Any use limitations assigned to the product will be designated on the Approved List.

**BASIS OF ACCEPTANCE.** Each shipment will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List, and a material certification indicating conformance to this specification. The Department reserves the right to monitor the performance of any previously approved cementitious material from actual concrete production. If the monitor test results indicate that the sampled product does not meet this specification, the concrete incorporating the product represented by the sample may be rejected.

#### **701-14 CHEMICALLY CURING ADHESIVES FOR PCC PAVEMENT APPLICATIONS**

**SCOPE.** This specification covers polymer anchoring materials for use in non-tension or non-continuous loading applications, specifically, the installation of dowel bars and longitudinal tie bars in Portland Cement Concrete (PCC) pavements.

**GENERAL.** The material shall be a non-metallic, non-shrink polymer resin supplied in prepackaged and/or premeasured containers. It shall contain no rust or corrosion promoting agents and shall be moisture insensitive. Packaged stability of each component in original unopened containers stored in temperatures between 40°F and 90°F shall be a minimum of six months. The mixing instructions, setting time and expiration date of the material shall appear on each container.

**CHEMICAL RESISTANCE.** Cured adhesive shall be resistant to most chemical reagents. The manufacturer shall certify that the adhesive meets the following chemical resistances when tested in accordance with ASTM D543 Method A:

- Gasoline
- Hydraulic Brake Fluid
- Motor Oil
- Sodium Chloride (5%)
- Calcium Chloride (5%)

**MATERIAL REQUIREMENTS.** Manufacturers shall supply independent test results meeting the following criteria:

**Pullout Testing:**

Use unreinforced concrete with a recommended compressive strength greater than 4000 psi. Test rods shall be 1inch diameter and 5/8-inch diameter, fully threaded steel.

A minimum of three tests for each diameter or test rod shall be performed and each test result must meet the minimum required pullout values. The minimum required pullout values for various concrete strengths are shown below:

<b>TABLE 701-1</b>				
<b>1 INCH DIAM. THREADED ROD WITH 10 INCH EMBEDMENT</b>				
Concrete Strength (psi)	≤ 4000	4500	5000	5500
Minimum Pullout Load (lb)	51,120	54,225	57,150	59,940

<b>TABLE 701-2</b>				
<b>5/8 INCH DIAM. THREADED ROD WITH 4 INCH EMBEDMENT</b>				
Concrete Strength (psi)	≤ 4000	4500	5000	5500
Minimum Pullout Load (lb)	8,593	9,113	9,630	10,080

Results from testing using lesser embedment depths will be accepted provided they achieve the minimum pullout strength required for the embedment depths noted in the tables above.

**BASIS OF APPROVAL.**

Application for approval of 701-14 Chemically Curing Adhesives for PCC Pavement Applications shall be submitted to the Materials Bureau by the Manufacturer accompanied by the products latest data sheets, MSDS sheets and independent test data conforming to the requirements of this specification. Additional laboratory analysis may be carried out by the Materials Bureau. Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.**

Chemically curing adhesives for PCC pavement applications will be accepted on the basis of the product appearing on the Approved List and a material certification that the product supplied is the same material that appears on the Approved List, and that it conforms to this specification.

**701-99 FOR SITE MANAGER USE**

**SECTION 702 - BITUMINOUS MATERIALS**

(Last Revised September, 2016)

**SCOPE.** These specifications cover the material requirements and testing methods of bituminous materials:

1. Performance-Graded (PG) Binders for Paving.
2. Miscellaneous Asphalt Cements.
3. Synthetic Resins.
4. Anionic and Cationic Asphalt Emulsions.
5. Polymer-Modified Asphalt Emulsions.
6. Asphalt Emulsion Diluted Tack Coat.
7. Asphalt Emulsion Straight Tack Coat.
8. Asphalt Recycling Agent.”

**GENERAL.** The bituminous material volume shall be measured at 60°F. The specific gravity at 60°F shall be included with each shipment of bituminous material to a plant or project site.

**MATERIAL REQUIREMENTS.** Bituminous materials shall meet the following requirements.

**1. Performance-Graded (PG) Binders for Paving.** The PG binder shall be manufactured by refining crude petroleum and blending with a modifier, if necessary, to meet the required performance grade specified in the contract documents. PG binders shall meet the requirements of Table 702-1 *Performance-Graded Binders for Paving*. The PG binder supplier shall:

- Certify that the PG binder meets NYSDOT requirements.
- Include type of modification and any special handling instructions in the certification if the PG binder is modified,
- Provide the design mixing and compaction temperatures on their bill of lading.
- Provide AASHTO M 332 test data and all necessary shipping documents in accordance with the Department’s Materials Method 702-1 Quality Assurance Procedure for Performance-Graded (PG) Asphalt Binders.

<b>TABLE 702-1 PERFORMANCE-GRADED BINDERS FOR PAVING</b>					
<b>MATERIAL DESIGNATION</b>	<b>702-58E34</b>	<b>702-64S22</b>	<b>702-64V22</b>	<b>702-64H22</b>	<b>702-64E22</b>
<b>PERFORMANCE-GRADE</b>	<b>PG 58E</b>	<b>PG 64S</b>	<b>PG 64V</b>	<b>PG 64H</b>	<b>PG 64E</b>
	<b>-34</b>	<b>-22</b>	<b>-22</b>	<b>-22</b>	<b>-22</b>
<b>Test Requirements</b>	<b>AASHTO M 332</b>				

Any PG binder previously approved that has been stored in the mixing plant tank over the winter shall be re-sampled and accepted by the Department before it is used.

**2. Miscellaneous Asphalt Cements.** Asphalt cements shall meet the requirements in Table 702-2 *Miscellaneous Asphalt Cements*. The asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 350°F. The supplier shall provide material test results and shipping documents that state the volume of material certified.

<b>TABLE 702-2 MISCELLANEOUS ASPHALT CEMENTS</b>		
<b>MATERIAL DESIGNATION</b>	<b>702-0700</b>	
<b>Test Requirements</b>	<b>Minimum</b>	<b>Maximum</b>
Penetration, 77°F (25°C), 100 g, 5 second (AASHTO T 49)	18	60
Flash Point, COC, °F (AASHTO T 48)	393	-
Solubility in trichloroethylene, % (AASHTO T 44)	99.5	-
Softening Point, °F (AASHTO T 53)	130	167
Loss on Heating, 325°F (163°C), 5 hour, % (AASHTO T 47)	-	1.0
Penetration of Residue, % of Original (AASHTO T 49)	60	-
Ductility, 77°F (25°C), 5 cm/minute, cm (AASHTO T 51)	5	-

**3. Synthetic Resins.** The synthetic resins covered under these specifications are two types: synthetic resin binder and rapid curing synthetic resin liquid. The synthetic resin binder is a light insensitive liquid used in colored synthetic resin binder concrete. The rapid curing synthetic resin liquid is a tack coat for the resin binder concrete and shall be light colored and compatible with the resin binder concrete placed

over it. The synthetic resin shall be homogeneous and shall meet the requirements in Table 702-3 *Synthetic Resins*.

<b>TABLE 702-3 SYNTHETIC RESINS</b>				
<b>TYPE</b>	<b>Resin Binder</b>		<b>Rapid Curing Resin Liquid</b>	
<b>MATERIAL DESIGNATION</b>	<b>702-7000</b>		<b>702-7100</b>	
<b>Test Requirements</b>	<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>
Penetration, 77°F (25°C), 100 g, 5 second	75	100	-	-
Viscosity, 140°F (60°C), m <sup>2</sup> /s (x 10 <sup>-6</sup> )	-	-	8	30
Flash Point, COC, °F	400	-	-	-
Solubility in trichloroethylene, %	99.5	-	99.5	-
Loss of Heating, 325°F (163°C), 5 hr., %	-	1.0	-	-
Water, %	-	0.0	-	0.2
Color, (30% binder/70% toluene) Gardner Standard Color Scale, (ASTM D 1544)	-	16	-	-
Test on Residue from Thin Film Oven Test, (AASHTO T 179)	47	-	-	-
Residue from Evaporation, 221°F (105°C), 3 hr., (ASTM D 1644), %	-	-	50	-
Suggested Spraying Temperature, °F	-	-	50	120
Typical Uses	Hot Plant Mix		Tack Coat	

**4. Anionic and Cationic Asphalt Emulsions.** The emulsion shall be homogeneous and show no separation of asphalt, after thoroughly mixing, within 30 days after delivery. The asphalt emulsion shall be agitated or circulated to ensure a homogeneous emulsion prior to sampling or application of material. Material that has separated due to freezing is unacceptable at any time.

Asphalt emulsions shall meet the requirements shown in Table 702-4 *Anionic Asphalt Emulsions*, or Table 702-5 *Cationic Asphalt Emulsions*. Test data and shipping documents shall be provided by the supplier in accordance with the Department's Materials Method 702-2 *Asphalt Emulsion – Quality Assurance*.

TABLE 702-4 ANIONIC ASPHALT EMULSIONS																				
TYPE	RAPID SETTING								MEDIUM SETTING								SLOW SETTING			
MATERIAL DESIGNATION	702-3001		702-3002		702-3101		702-3102		702-3201		702-3301		702-3401		702-3402		702-3501		702-3601	
GRADE	RS-1		RS-1h		RS-2		HFRS-2		MS-2		HFMS-2		HFMS-2h		HFMS-2s		SS-1		SS-1h	
Test Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
<b>Emulsion<sup>(1)</sup>.</b>																				
Viscosity, Saybolt Furol, 77°F (25°C), second	20	100	20	100	-	-	-	-	100	-	100	-	100	-	50	-	20	100	20	100
Viscosity, Saybolt Furol, 122°F (50°C), second	-	-	-	-	75	400	75	400	100	400	100	400	-	-	-	-	-	-	-	-
Storage Stability Test, 1 Day (Difference in % Residue)	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1
Demulsibility, 35 mL, 0.02 N, CaCl <sub>2</sub> , %	60	-	60	-	60	-	60	-	-	-	-	-	-	-	-	-	-	-	-	-
Cement Mixing Test <sup>(2)</sup> , %	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Sieve Test, %	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10
Residue by Distillation, %	55	-	55	-	63	-	63	-	65	-	65	-	65	-	65	-	57	-	57	-
Oil Distillate, Volume Total Emulsion, %	-	1.5	-	1.5	-	2.5	-	2.5	-	8	-	8	-	8	-	8	-	1.5	-	1.5
<b>Residue from Distillation Test<sup>(1)</sup>.</b>																				
Penetration, 77°F (25°C), 100 g, 5 second	100	200	40	90	100	200	100	200	100	200	100	200	40	90	200	-	100	200	40	90
Ductility, 77°F (25°C), 5 cm/minute, cm	40	-	40	-	40	-	40	-	40	-	40	-	40	-	40	-	40	-	40	-
Solubility in trichloroethylene, %	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-
Float Test <sup>(3)</sup> , 140°F (60°C), second	-	-	-	-	-	-	-	1200	-	-	-	1200	-	1200	-	1200	-	-	-	-

1. All tests performed per AASHTO T 59 unless otherwise noted.
2. The Cement Mixing test is waived if the emulsion will be used for soil stabilization.
3. Float Test AASHTO T 50, except that the residue from distillation shall be poured immediately into the float collar at 500°F (260°C)

TABLE 702-5 CATIONIC ASPHALT EMULSIONS																
TYPE	RAPID SETTING						MEDIUM SETTING				SLOW SETTING				QUICK SETTING	
MATERIAL DESIGNATION	702-4001		702-4002		702-4101		702-4201		702-4301		702-4401		702-4501		702-4601	
GRADE	CRS-1		CRS-1h		CRS-2		CMS-2		CMS-2h		CSS-1		CSS-1h		CQS-1h	
Test Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
<b>Emulsion<sup>(1)</sup>.</b>																
Viscosity, Saybolt Furol, 77°F (25°C), second	20	100	20	100	-	-	-	-	-	-	20	100	20	100	20	100
Viscosity, Saybolt Furol, 122°F (50°C), second	-	-	-	-	100	400	50	450	50	450	-	-	-	-	-	-
Storage Stability Test, 1 Day (Difference in % Residue)	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1
Classification Test	Passes		Passes		Passes		---		---		---		---		---	
Particle Charge Test <sup>(2)</sup>	Positive		Positive		Positive		Positive		Positive		Positive		Positive		Positive	
Sieve Test, %	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10
Cement Mixing Test <sup>(3)</sup> , %	-	-	-	-	-	-	-	-	-	-	-	2.0	-	2.0	-	-
Residue by Distillation, %	60	-	60	-	65	-	65	-	65	-	57	-	57	-	62	-
Oil Distillate, Volume Total Emulsion, %	-	1.5	-	1.5	-	2.5	-	10	-	10	-	1.5	-	1.5	-	-
<b>Residue from Distillation Test<sup>(1)</sup>.</b>																
Penetration, 77°F (25°C), 100 g, 5 second	100	250	40	90	100	250	100	250	40	90	100	250	40	90	40	90
Ductility, 77°F (25°C), 5 cm/minute, cm	40	-	40	-	40	-	40	-	40	-	40	-	40	-	40	-
Solubility in trichloroethylene, %	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

1. All tests performed per AASHTO T 59 unless otherwise noted.
2. If the Particle Charge test is inconclusive, material having a maximum pH value of 6.7 will be accepted.
3. The Cement Mixing test is waived if the emulsion will be used for soil stabilization.

5. **Polymer-Modified Asphalt Emulsions.** Polymer-modified asphalt emulsions shall meet the requirements of Table 702-4 and 702-5 except as modified in Table 702-6 *Polymer Modified Asphalt Emulsions*.

The polymer modifier shall be milled or blended into the base asphalt or emulsifying agent prior to the emulsification process.

TABLE 702-6 POLYMER MODIFIED ASPHALT EMULSIONS		
MATERIAL DESIGNATION	702-XXXXP <sup>(1)</sup>	
Emulsion Grade	Test Requirement	Minimum
CQS-1h – 702-4601	Elastic Recovery at 50°F(10°C) <sup>(2,3)</sup> , %	40

	Softening Point, °F <sup>(4)</sup>	140
All Other Polymer Modified Emulsions	Elastic Recovery at 50°F(10°C) <sup>(2,3)</sup> ,%	50

1. XXXX shall be the four digit code matching the appropriate emulsion grade listed in table 702-4 & 702-5
2. Elastic Recovery procedure: Use ASTM D 6084 Testing Procedure “A.” Samples will be tested at 50°F (10°C).
3. Recover emulsion’s asphalt residue according to ASTM D 6997 except as modified herein, when the lower temperature reaches approximately 275°F (135°C), move the ring burner approximately level with the bottom of the still. Increase the temperature to a maximum 350°F +/- 10°F (177°C +/- 5°C), maintaining this temperature for 15 minutes.
4. According to AASHTO T 53

**6. Asphalt Emulsion – Diluted Tack Coat.** Diluted tack coat emulsion shall be agitated or circulated to ensure a homogeneous emulsion prior to sampling or application of material. The consistency of the diluted tack coat shall be appropriate for pumping and uniform application.

Only the grades of emulsions meeting the requirements of Table 702-7 *Diluted Tack Coat* shall be allowed. These diluted tack coats may be produced by diluting the base asphalt emulsion grade with an emulsifier and/or water and thoroughly mixing into a homogeneous liquid.

MATERIAL DESIGNATION		702-XXXXT <sup>(1)</sup>	
Emulsion Grades	Test Requirements <sup>(2)</sup>	Min.	Max.
702-3401 702-3601 702-4501	Sieve Test	-	0.10
	Residue by Distillation, %	38	50
	Oil Distillate, Volume of Total Emulsion, %	-	2
	<b>Test on Residue from Distillation:</b>		
	Penetration, 77°F (25°C), 100 g, 5 seconds	40	90

1. XXXX = 3401, 3601 or 4501
2. All tests performed per AASTHO T59

**7. Asphalt Emulsion – Straight Tack Coat.** Straight tack coat emulsion shall be agitated or circulated to ensure a homogeneous emulsion prior to sampling or application of material. The consistency of the straight tack coat shall be appropriate for pumping and uniform application.

Only the grades of emulsions meeting the requirements of Table 702-8 *Straight Tack Coat* shall be allowed in straight tack coat applications. These tack coats shall not be further diluted with water.

MATERIAL DESIGNATION		702-XXXXT <sup>(1)</sup>	
Emulsion Grades	Test Requirements <sup>(2)</sup>	Min.	Max.
702-3002 702-4002	Sieve Test, %	-	0.10
	Residue by Distillation – Grade 702-3002, %	55	-
	Residue by Distillation – Grade 702-4002, %	60	-
	Oil Distillate, Volume of Total Emulsion, %	-	2

<b>Test on Residue from Distillation:</b>		
Penetration, 77°F (25°C), 100 g, 5 seconds	40	90

1. XXXX = 3002 or 4002
2. All tests performed per AASTHO T59

**8. Asphalt Recycling Agent** – Asphalt Recycling agents are used for heater scarification or hot in-place recycling projects.

Use ASTM D 4552, *Standard Practice for Classifying Hot-Mix Recycling Agents*, grades RA25 and RA75 petroleum-based recycling agents specifically designed as a rejuvenator meeting the requirements in Table 702-9 *Recycling Agent*. Use *Emulsified Recycling Agents*, grades ERA25 (an emulsified RA25) and ERA75 (an emulsified RA75) petroleum-based recycling agents specifically designed as a rejuvenator meeting the requirements in Table 702-10 *Emulsified Recycling Agent*.

<b>MATERIAL DESIGNATION (GRADE)</b>		<b>702-5030 (RA25)</b>		<b>702-5050 (RA75)</b>	
<b>Test Requirements</b>	<b>Test Method</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>
Tests on Residue from Distillation: Viscosity, 140°F (60°C), cSt Flash Point, CSC, °F	T 201	901	4500	4501	12500
	T 48	426	--	426	--
Test on Residue from RTFO, 325°F (163°C): Viscosity Ratio Weight Change, ±, %	T 240	--	3	--	3
		--	3	--	3
Specific Gravity	T 228	Report		Report	

<b>MATERIAL DESIGNATION (GRADE)</b>		<b>702-5031 (ERA25)</b>		<b>702-5051 (ERA75)</b>	
<b>Test Requirements</b>	<b>Test Method</b>	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>
Tests on Residue from Distillation: Viscosity, 140°F (60°C), cSt Flash Point, CSC, °F	T 201	901	4500	4501	12500
	T 48	426	--	426	--
Test on Residue from RTFO, 325°F (163°C): Viscosity Ratio Weight Change, ±, %	T 240	--	3	--	3
		--	4	--	4
Specific Gravity	T 228	Report		Report	
Saybolt Furol Viscosity @ 77°F (25°C), sec.	T 59	20	100	20	100
Storage Stability, 24 hrs, %		--	1.5	--	1.5



Sieve, %		--	0.1	--	0.1
Residue, by distillation, %		65	--	65	--

**BASIS OF APPROVAL.** The procedural directives for sampling, testing, and certifying the bituminous material, and for achieving and maintaining Approved List status, are available from the Materials Bureau.

**BASIS OF ACCEPTANCE.** PG binder will be accepted based on the Primary Source appearing on the approved list and the source’s certification and satisfactory test results from samples taken where the material is incorporated into the work.

Miscellaneous asphalt cements and synthetic resins will be accepted based on the manufacturer’s certification.

Asphalt Emulsions, including Tack Coat, will be accepted based on the Primary Source appearing on the approved list, the source’s certification, and satisfactory test results from samples taken where the material is incorporated into the work.

Asphalt Rejuvenating Agent will be accepted based on the manufacturer’s certification. The use of any other grade of recycling agent requires prior approval from the Director, Materials Bureau.

**702-05 FOR SITE MANAGER USE**

**702-07 FOR SITE MANAGER USE**

**702-09 FOR SITE MANAGER USE**

**702-11 THRU 702-16 FOR SITE MANAGER USE**

**702-20 THRU 702-25 FOR SITE MANAGER USE**

**702-30 THRU 702-38 FOR SITE MANAGER USE**

**702-40 THRU 702-48 FOR SITE MANAGER USE**

**702-50 FOR SITE MANAGER USE**

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**702-99 FOR SITE MANAGER USE**

## SECTION 703 - AGGREGATES

(Last Revised January, 2021)

### 703-01 FINE AGGREGATE

**SCOPE.** The specification covers the material details, quality requirements and policies for sampling and testing fine aggregate generally used in portland cement concrete and asphalt mixtures.

**SAMPLING.** Samples of fine aggregates will be obtained and submitted to the Materials Bureau by a representative of the Department under the following conditions:

**A. *Sampling Approved Sources.*** All approved sources will be sampled when:

- The latest test for a source is two (2) or more years old.
- A change in the character of the raw or processed fine aggregate occurs.
- Considered necessary by the Department.

**B. *Sampling Non-approved Sources.*** Non-approved or rejected sources, equipped with adequate processing facilities, may be sampled upon favorable recommendation by a Regional Director and approved by the Director, Materials Bureau. Approval action on such sources may be conditioned on the results obtained by periodic sampling and testing as prescribed by the Materials Bureau and described in Material Method 29, "Aggregate Source Acceptance Procedures" (MM 29). MM 29 is available on the NYSDOT public website here:

<https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**C. *Sampling Proposed Unopened Sources of Material.*** Proposed unopened sources of material may be sampled upon the favorable recommendation of a Regional Director and approved by the Director, Materials Bureau. The results of tests on such samples will be for information only and will be indicative of the potential quality of the source. Action regarding acceptance of a source is described in MM 29.

**Geologic Source Reports and Quality Control Plans.** As part of the source approval requirements, the following information shall be submitted to the Department for each source, according to the requirements in MM 29:

- A. Geologic Source Report (Static Module). The Static Module contains basic geology and mining information. It includes all relevant information about an aggregate source that is not likely to change over the lifetime of a mine. It is required to be submitted for the initial approval of an aggregate source. The requirements are detailed in MM 29.
- B. Geologic Source Report (Cyclic Module). The Cyclic Module contains geologic information such as maps and cross-sections that may change as a mining operation advances laterally or vertically and must be updated according to the schedule and requirements in MM 29.
- C. Quality Control Plan (Annual Module). The Annual Module contains the Quality Control Plan (QCP) and procedures for mining and processing aggregates; the plan must be submitted at least annually, or whenever changes occur.

Details of these requirements may be obtained from MM 29. These reports will be received and reviewed by the Department according to the schedules contained in MM 29.

The submittal and/or Department acceptance of a report does not relieve the supplier of its responsibility to provide a uniform product meeting the additional requirements described herein.

**MATERIAL REQUIREMENTS.** Fine aggregate shall consist of natural sand or manufactured sand, or other engineered aggregate conforming to the requirements of these specifications. All fine aggregate shall consist of hard, strong, durable particles meeting the requirements of Table 703-1, Fine Aggregate Requirements (Testing). In addition, such particles must be free from coatings or any injurious materials and/or injurious amounts of clay, loam, or other deleterious substances. Engineered aggregate includes any other materials that are inert, non-reactive, and meet all relevant specifications described herein. In addition, the fine aggregate shall not contain substances, which, when mixed in portland cement concrete, produce an unacceptable level of chloride ions in the final product. Substances that produce chloride ions will be considered deleterious material. Any fine aggregate may be rejected if it is determined by the Department to contain unacceptable amounts of unsound or deleterious material that is harmful or detrimental to an end-use product.

Fine aggregates from more than one approved aggregate source or of more than one type of material may be blended and stockpiled to meet gradation requirements or improve aggregate quality for any end-use. All blending procedures and proportions must be approved by the Department, and all resulting blends require a new source designation. Producers of blended fine aggregates are subject to all requirements of §703-01, including testing and Quality Control Plans.

Fine aggregates meeting the physical testing requirements of Table 703-1, “Fine Aggregate Requirements (Testing)” may be accepted for the indicated use, unless service records indicate that it is unsound, or that the material is otherwise determined to be unsatisfactory by the Director, Materials Bureau.

<b>TABLE 703-1 FINE AGGREGATE REQUIREMENTS (TESTING)</b>		
<b>Test Method</b>	<b>For use in Portland Cement Concrete (PCC)</b>	<b>For use in Asphalt Mixtures (HMA/WMA)</b>
Magnesium Sulfate Soundness (NY 703-06P,G) Max. percent loss by weight at 5 cycles	30	45
Organic Impurities (NY 703-03P,G, AASHTO T-21) Organic Plate, Lighter Than or Equal to	3	-
Gardner Color (AASHTO T-21), Lighter Than Or Equal to	14	-

Fine aggregate not meeting the requirement of Table 703-1 may be further evaluated by additional testing, petrographic examination, geologic studies, review of plant flow information, or investigation of performance history. If the results of the evaluation indicate that the aggregate should perform satisfactorily, the source may be accepted by the Director, Materials Bureau.

If fine aggregate is found unsatisfactory when examined for organic impurities, it will be rejected unless it passes the mortar strength test for compression (NY 703-04P). Fine aggregates so tested shall achieve a compressive strength of at least one hundred percent of the matching washed fine aggregate.

**FRICITION.** Fine aggregate for use in wearing surfaces of portland cement concrete pavement must meet the friction aggregate requirements of §501, Portland Cement Concrete.

**TESTS.** The details of all test methods for fine aggregates may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF APPROVAL.** Approval of the source is determined based on tests performed by the Materials Bureau on samples representing the source; review of Geologic Source Reports and Quality Control Plans; petrographic examination and other geologic studies; and performance histories where applicable.

**BASIS OF ACCEPTANCE.** The material is incorporated into the work on the basis that it is from an approved source conforming to procedural directives of the Department and the aggregate shall meet the gradation requirement at the point of use.

Aggregate for use in the manufacture of precast concrete units may be accepted based on stockpile approval at a location acceptable to the Department on a per job basis. Requests for stockpile approval shall be made in writing to the Materials Bureau. The manufacturer shall allow at least ninety (90) days for the testing and evaluation of the aggregate.

### **703-02 COARSE AGGREGATE**

**SCOPE.** This specification covers the material details, requirements and methods for sampling and testing coarse aggregate generally used in portland cement concrete, asphalt mixtures and surface treatments. This specification does not cover those aggregates used solely as part of certain proprietary non-structural overlays or surface treatment systems.

**SAMPLING.** Samples of coarse aggregates will be obtained by and submitted to the Materials Bureau by a representative of the Department under the following conditions:

**A. Sampling Approved Sources.** All approved sources will be sampled when:

- The latest test for a source is two (2) or more years old.
- A change in the character of raw or processed coarse aggregate occurs.
- Considered necessary by the Department.

**B. Sampling Non-approved Sources.** Non-approved or rejected sources, equipped with adequate processing facilities, may be sampled upon favorable recommendation by a Regional Director and approval by the Director, Materials Bureau. Approval action on such sources may be conditioned on the results obtained by periodic sampling and testing as prescribed by the Materials Bureau and described in MM 29.

**C. Sampling Proposed Unopened Sources of Material.** Proposed unopened sources of material may be sampled upon the favorable recommendation of a Regional Director and approval by the Director, Materials Bureau. The results of tests on such samples will be for information only and will be interpreted as indicative of the potential quality of the source. Action regarding acceptance of a source is described in MM 29. MM 29 is available on the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**GEOLOGIC SOURCE REPORTS AND QUALITY CONTROL PLANS.** As part of the acceptance requirements, the following information shall be submitted to the Department for each operating source, according to the requirements in MM 29:

- A.** Geologic Source Report (Static Module). The Static Module contains basic geology and mining information. It includes all relevant information about an aggregate source that is not

likely to change over the lifetime of a mine. It is required to be submitted for the initial approval of an aggregate source. The requirements are detailed in MM 29.

- B. Geologic Source Report (Cyclic Module). The Cyclic Module contains geologic information such as maps and cross-sections that may change as a mining operation advances laterally or vertically and must be updated according to the schedule and requirements in MM 29.
- C. Quality Control Plan (Annual Module). The Annual Module contains the Quality Control Plan (QCP) and procedures for mining and processing aggregates; the plan must be submitted at least annually, or whenever changes occur.

Details of these report requirements may be obtained from MM 29. These reports will be received and reviewed by the Department according to the schedules contained in MM 29.

The submittal and/or Department acceptance of a report does not relieve the supplier of its responsibility to provide a uniform product meeting the additional requirements described herein.

<b>TABLE 703-2 COARSE AGGREGATE PHYSICAL REQUIREMENTS (TESTING)</b>				
<b>Test Designation</b>	<b>Material Designation</b>			
	<b>Gradation/ Particle Size</b>	<b>Crushed Bedrock 703-0201</b>	<b>Crushed Gravel 703-0202</b>	<b>Crushed Slag 703-0204</b>
Magnesium Sulfate Soundness (NY 703-07P,G) Max. % loss by weight at 10 cycles <sup>(1)</sup>	No. 2	18	18	6
	No. 1	32	32	6
Freezing and Thawing Test (NY 703-08P,G) Max. % loss by weight at 25 cycles <sup>(2)</sup>	No. 2	20	20	-
	No. 1	25	25	-
Flat Particles, Elongated Particles, or Flat and Elongated Particles (ASTM D4791) Max. % by weight Flat and Elongated to the Degree of 5:1 <sup>(3)</sup>		10	10	-
Crushed particles in any primary size (ASTM D5821) Min. % by weight	+½ inch with 1 fractured face	-	75 <sup>(4)</sup>	-
	-½ inch with 2 fractured faces		85 <sup>(4)</sup>	
Minimum unit weight (NY 703-10P,G) lbs/cu. ft.		-	-	70

1. The loss on either size fraction may be used for acceptance if they are of similar composition.
2. The freeze-thaw requirement applies only to aggregate used in Portland cement concrete. The loss on either size fraction may be used for acceptance if they are of similar composition.
3. Requirement applies to coarse aggregate for use in asphalt mixtures with design ESALs of 0.3 million or greater.
4. Gravel which has not been processed through a crusher shall not be combined with crushed gravel.

**MATERIAL REQUIREMENTS.** Coarse aggregates shall consist of crushed bedrock, crushed gravel, crushed air-cooled blast furnace slag, or other engineered aggregate conforming to the requirements of these specifications. All coarse aggregates shall meet the requirements in Tables 703-2 Coarse Aggregate Physical Requirements (Testing), 703-3 Coarse Aggregate Physical Requirements (Deleterious Materials), and 703-4 Size of Crushed Bedrock, Gravel and Slag.

Engineered aggregate includes any other materials that are inert, non-reactive, and meet all relevant specifications described herein.

Coarse aggregates from more than one approved aggregate source or of more than one type of material may be blended and stockpiled to meet gradation requirements or improve aggregate quality for any end-use. All blending procedures and proportions must be approved by the Department, and all resulting blends require a new source designation. Producers of blended coarse aggregates are subject to all requirements of §703-02, including testing and Quality Control Plans.

<b>TABLE 703-3 COARSE AGGREGATE PHYSICAL REQUIREMENTS (DELETERIOUS MATERIALS)</b>			
<b>Maximum percent by weight in any primary size <sup>(1)</sup></b>			
<b>Material Designation</b>	<b>Crushed Bedrock 703-0201</b>	<b>Crushed Gravel 703-0202</b>	<b>Crushed Slag 703-0204</b>
Shale and shale-like materials <sup>(2)</sup>	3.0	3.0	-
Coal/Lignite/Sulfides <sup>(3)</sup>	1.0	1.0	-
Clay lumps or Wood	0.2	0.2	-
Metal Ore <sup>(4)</sup>	3.0	3.0	3.0
Other Deleterious Materials <sup>(5)</sup>	3.0	3.0	3.0
<b>Total Deleterious Materials</b>	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>

1. Coarse aggregates containing more than the specified maximum amounts of deleterious materials may be washed or otherwise processed until such specifications are satisfied.
2. Shale, slate, phyllite, argillite, schist, and similar shale-like fissile rocks that have been identified by performance or by test to be unsound and deleterious. Such shale-like fissile rocks may be tested separately from the rest of the aggregate by freezing and thawing according to Test Method NY 703-08P,G. If the loss is 20% or greater, that material will be designated as deleterious shale or shale-like material.
3. Pyrite, marcasite, pyrrhotite, bog iron, and similar material.
4. Magnetite, illmenite, etc. Percentages above 3.0% may be accepted by the Director, Materials Bureau, when appropriate adjustments to yield have been made.
5. Cemented clusters, weathered particles, and similar material.

Coarse aggregate meeting the physical requirements of Tables 703-2, and 703-3 may be accepted unless service records indicate that it is unsound or that the material is otherwise determined to be unsatisfactory by the Director, Materials Bureau. Coarse aggregate not meeting the requirements of these tables may be further evaluated by additional testing, petrographic examination, geologic studies, review of Plant Flow Information and performance history. If the results of the evaluation indicate that the aggregate should perform satisfactorily, the source may be accepted by the Director, Materials Bureau.

**A. Crushed Bedrock.** Crushed bedrock will be Material Designation 703-0201 and shall consist of clean, durable, sharp-angled fragments of rock of uniform quality.

**B. Crushed Gravel.** Crushed Gravel will be Material Designation 703-0202 and shall consist of clean, durable, sharp-angled fragments of gravel that are free from coatings. A crushed particle is defined as one in which the total area of face fracture exceeds 25% of the maximum cross-sectional area of the particle. When two fractured faces are designated, the total area of each fractured face shall exceed 25% of the maximum cross-sectional area of the particle. A

naturally fractured face will be acceptable providing that the sharp angular portion of the particle consists of sound material and is free from unsound or injurious coatings.

**C. Crushed Slag.** Crushed slag particles will be Material Designation 703-0204 and shall consist of hard, durable, angular fragments which are reasonably uniform in density and quality; free from injurious amounts of sulfur; and reasonably free from thin, elongated pieces, dirt, or other objectional matter.

<b>TABLE 703-4 SIZES OF CRUSHED BEDROCK, GRAVEL AND SLAG</b>											
	<b>Screen Sizes (% Passing by Weight)</b>										
<b>Size</b>	<b>4 in</b>	<b>3 in</b>	<b>2 ½ in</b>	<b>2 in</b>	<b>1 ½ in</b>	<b>1 in</b>	<b>½ in</b>	<b>¼ in</b>	<b>1/8 in</b>	<b>#80</b>	<b>#200<sup>(2)</sup></b>
Screenings <sup>(1)</sup>	-	-	-	-	-	-	100	90-100	-	-	0-1.0
1B	-	-	-	-	-	-	-	100	90-100	0-15	0-1.0
1A	-	-	-	-	-	-	100	90-100	0-15	-	0-1.0
1ST	-	-	-	-	-	-	100	0-15	-	-	0-1.0
1	-	-	-	-	-	100	90-100	0-15	-	-	0-1.0
2	-	-	-	-	100	90-100	0-15	-	-	-	0-1.0
3A	-	-	-	100	90-100	0-15	-	-	-	-	0-0.7
3	-	-	100	90-100	35-70	0-15	-	-	-	-	0-0.7
4A	-	100	90-100	-	0-20	-	-	-	-	-	0-0.7
4	100	90-100	-	0-15	-	-	-	-	-	-	0-0.7
5	90-100	0-15	-	-	-	-	-	-	-	-	0-0.7

1. Screenings shall include all the material passing a 1/4 in. screen.
2. The minus No. 200 material requirements apply only to aggregate for use in portland cement concrete, chip seal, cold mix asphalt pavements and underdrain filter material. The test (AASHTO T11) will be performed on the entire sample of the designated size aggregate. Primary size does not apply in the determination of the minus No. 200 material.

<b>TABLE 703-5 SIZES OF CRUSHED BEDROCK, GRAVEL, AND SLAG FOR MICROSURFACING AND SLURRY SURFACING</b>								
	<b>Screen Sizes (% Passing by Weight)</b>							
<b>Size Designation</b>	<b>3/8 in</b>	<b>No. 4</b>	<b>No. 8</b>	<b>No. 16</b>	<b>No. 30</b>	<b>No. 50</b>	<b>No. 100</b>	<b>No. 200<sup>(1)</sup></b>
2MS	100	90-100	65-90	45-70	30-50	18-30	10-22	5-15
3MS	100	70-90	45-70	28-50	19-34	12-25	7-20	5-15

1. Determine percent passing No. 200 sieve according to AASHTO T 11, Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.

<b>TABLE 703-6 PRIMARY SIZES</b>					
<b>Size Designation</b>	<b>Primary Screen Sizes</b>		<b>Size Designation</b>	<b>Primary Screen Sizes</b>	
	<b>Passing</b>	<b>Retained</b>		<b>Passing</b>	<b>Retained</b>
1B	1/8 in	No. 80	3A	1 1/2 in	1 in
1A	1/4 in	1/8 in	3	2 in	1 in
1ST	1/2 in	1/4 in	4A	2 1/2 in	1 1/2 in

1	1/2 in	1/4 in	4	3 in	2 in
2	1 in	1/2 in	5	4 in	3 in

**Gradation.** The gradation ranges for each nominal NYSDOT Size Designation of crushed bedrock, gravel or slag used under these specifications shall conform to the gradation requirements for the various Size Designations tabulated in Table 703-4 or Table 703-5. Alternate gradation size designations such as AASHTO or ASTM may be used to produce asphalt or concrete mixtures, or any other end products used in construction projects, if the end product gradation targets are met.

**Primary Size.** For the purposes of this specification, the term “Primary Size” is defined for each size designation as all of the material passing and retained on the screens specified in Table 703-6 “Primary Sizes.”

**FRICITION.** Coarse aggregate for use in wearing surfaces of portland cement concrete pavement must meet the friction aggregate requirements of §501, Portland Cement Concrete. Coarse aggregate for use in top courses of asphalt pavements must meet the friction aggregate requirements of §401, Hot Mix Asphalt.

**TESTS.** The details of test methods for coarse aggregate may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF APPROVAL.** Approval of the source is determined based on tests performed by the Materials Bureau on samples representing the source; review of Geologic Source Reports and Quality Control Plans; petrographic examination and other geologic studies; and performance history where applicable.

**BASIS OF ACCEPTANCE.** The material is incorporated into the work on the basis that it is from an approved source conforming to procedural requirements of the Department and that the aggregate shall meet gradation at the point of use.

Aggregate for use in the manufacture of precast concrete units may be accepted based on stockpile approval at a location acceptable to the Department on a per job basis. Requests for stockpile approval shall be made in writing to the Materials Bureau. The manufacturer shall allow at least ninety (90) days for the testing and evaluation of the aggregate.

### 703-03 MORTAR SAND

**SCOPE.** This specification contains the requirements for sand used in mortar.

**GENERAL.** §703-01, Fine Aggregate requirements for use in Portland cement concrete shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, mortar sand shall meet the following gradation requirements:

Table 703-7 Mortar Sand Gradation	
Sieve Size	Percent Passing by Weight



<b>No. 4</b>	100
<b>No. 8</b>	95-100
<b>No. 50</b>	10-40
<b>No. 100</b>	0-15

Concrete sand, §703-07, will be permitted as an alternative to mortar sand.

**TEST.** Test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF ACCEPTANCE.** The provisions of §703-01, Fine Aggregate, shall apply.

### 703-04 GROUT SAND

**SCOPE.** This specification contains the requirements for sand used in grout.

**GENERAL.** §703-01, Fine Aggregate requirements for use in Portland cement concrete, shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, the grout sand shall meet the following gradation requirements:

<b>Table 703-8 Grout Sand Gradation</b>	
<b>Sieve Size</b>	<b>Percent Passing by Weight</b>
<b>No. 16</b>	100
<b>No. 100</b>	0-10

The sand may be determined to be unacceptable for grout sand if it contains more than 6 percent by volume of loam and silt.

**TEST.** Test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF ACCEPTANCE.** The provisions of §703-01, Fine Aggregate, shall apply.

### 703-05 FINE AGGREGATE FOR WHITE PORTLAND CEMENT CONCRETE

**SCOPE.** This specification contains the requirements for white fine aggregate used in the white portland cement concrete.

**MATERIALS REQUIREMENT.** Material Specification §703-01, Fine Aggregate, shall apply except as modified herein. The aggregate shall be white, having a Munsell color with a value of 8 or greater and a chroma saturation of 2 or less, when compared to a set of standard color chips. Gradation shall conform to the specification requirement under §703-07, Concrete Sand.

**TEST.** The details of the test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF ACCEPTANCE.** The provisions of §703-01 Fine Aggregate requirements for use in Portland cement concrete, shall apply except that the color will be accepted on a per stockpile basis by the Director, Materials Bureau.

**703-06 CUSHION SAND**

**SCOPE.** This specification contains the requirements for cushion sand used for concrete block slope paving.

**GENERAL.** Material for cushion sand shall meet the requirements specified herein.

**MATERIAL REQUIREMENTS.** Cushion sand shall consist of clean, hard, durable, uncoated particles, free from lumps of clay and all deleterious substances.

When dry, the cushion sand shall meet the following gradation requirements:

Table 703-9 Cushion Sand Gradation	
Sieve Size	Percent Passing by Weight
¼ in	100
No. 50	0-35
No. 100	0-10

**TEST.** Test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF ACCEPTANCE.** The cushion sand is accepted based on gradation tests and visual inspection, unless otherwise specified, at the point of use.

**703-07 CONCRETE SAND**

**SCOPE.** This specification contains the requirements for sand used in portland cement concrete.

**GENERAL.** §703-01, Fine Aggregate requirements for use in Portland cement concrete, shall apply except as modified herein.

**MATERIAL REQUIREMENTS.** When dry, the fine aggregate for portland cement concrete shall conform to the following gradation requirements:

Table 703-10 Concrete Sand Gradation		
Sieve Size	Percent Passing by Weight	
	Minimum	Maximum
3/8 in	100	-
No. 4	90	100
No. 8	75	100

No. 16	50	85
No. 30	25	60
No. 50	10	30
No. 100	1	10
No. 200 (Wet)	0	3

**TEST.** Test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**FRICITION.** Sand for use in wearing surfaces of portland cement concrete pavement (including bridge deck and approach slab wearing surfaces) must meet the friction aggregate requirements of §501, Portland Cement Concrete.

**BASIS OF ACCEPTANCE.** The provisions of 703-01, Fine Aggregates, shall apply.

### 703-08 MINERAL FILLER

**SCOPE.** This specification contains the requirements for mineral filler used in hot mix asphalt concrete mixtures.

**MATERIAL REQUIREMENTS.** Mineral filler shall conform to the requirements of the standard specification for Mineral Filler for Asphalt Mixtures, ASTM D242. When dry, the mineral filler shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
No. 30	100
No. 50	95-100
No. 200	70-100

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the producer's certification of compliance with these specification requirements.

### 703-09 (VACANT)

### 703-10 LIGHTWEIGHT AGGREGATES

**SCOPE.** This specification covers the material details and quality requirements for lightweight aggregates generally used in structural portland cement concrete.

**GENERAL.** The provisions of Sampling and Geologic Source Reports under §703-02 Coarse Aggregate shall apply.

**MATERIAL REQUIREMENTS.** The lightweight aggregates shall be prepared by thermally expanding, pelletizing, or sintering materials such as shale, slate, clay, fly ash or blast furnace slag, or by processing natural materials such as pumice. The requirements of ASTM C330 shall apply except as modified in these specifications. In addition to ASTM C330, the lightweight aggregates shall meet the requirements

given in Table 703-10, Lightweight Aggregate Requirements (Testing). The Durability Factor of concrete made from lightweight aggregates, as determined in accordance with ASTM C666, shall not be less than 80 percent.

TABLE 703-12 LIGHTWEIGHT AGGREGATE REQUIREMENTS (TESTING)		
Test Method	Fine Aggregate	Coarse Aggregate
Magnesium Sulfate (NY 703-06P,G). Max. % Loss by Weight after 5 cycles.	30	-
Magnesium Sulfate (NY 703-07P,G). Max. % Loss by Weight after 10 cycles.	-	18/32 <sup>(1)</sup>
Los Angeles Abrasion Test (ASTM C131). Max % Loss by Weight (Grading B or C).	-	50

1. 18% Maximum applies to No. 2 size aggregate. 35% Maximum loss applies to No. 1 size aggregate.

A lightweight aggregate meeting the requirements of this specification will be accepted unless service records indicate that the aggregate is unsound or that the material is otherwise determined to be unsatisfactory by the Director, Materials Bureau. Lightweight aggregates not meeting these requirements may be further evaluated by additional testing, petrographic examination, geologic studies, a review of the lightweight aggregate processing and the performance history. If the results of the evaluation indicate that the lightweight aggregate should perform satisfactorily, the material may be accepted by the Director, Materials Bureau.

**TEST.** Test methods may be obtained from ASTM, AASHTO, or the NYSDOT public website here: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals>.

**BASIS OF APPROVAL.** Approval of the source is determined on the basis of tests performed by the Materials Bureau on samples representing the source; review of Geologic Source Reports and Quality Control Plans; petrographic examination and other geologic studies; and performance histories where applicable.

**BASIS OF ACCEPTANCE.** Acceptance of lightweight aggregates is determined by the Director, Materials Bureau based on tests performed by the Materials Bureau on representative samples of the materials; review of Geologic Source Reports; petrographic examination and other geologic studies; and performance histories where applicable. The material is incorporated into the work on the basis that it is accepted and conforms to procedural directives of the Department and the aggregate shall meet the gradation requirement at the point of use.

**703-90 FOR SITE MANAGER USE**

**703-91 FOR SITE MANAGER USE**

**703-99 FOR SITE MANAGER USE**

## SECTION 704 - MASONRY UNITS

**704-01 COMMON BRICK**

**SCOPE.** This specification covers the material and quality requirements for common brick, made from clay or shale, used in the construction of drainage structures and manholes.

**MATERIAL REQUIREMENTS.** Brick shall conform to the requirements of ASTM C32, Grade MS, including the requirement for saturation coefficient. Common brick may be furnished in any of the designated standard sizes that will produce the required dimensions in the completed structure, and the bricks shall be solid.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size bricks of the same size and style will be required. Samples will be tested for the physical properties identified in ASTM C32. Tests will be performed in accordance with ASTM 67.

**BASIS OF ACCEPTANCE.** Common brick will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **704-02 CONCRETE BRICK**

**SCOPE.** This specification covers the material and quality requirements for concrete brick produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled “Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status”. Item 704-02 can be used in brick masonry construction, altering drainage structures, leaching-basins and manholes (section 604).

**MATERIAL REQUIREMENTS.** Concrete brick shall conform to the requirements of ASTM C936, except as noted herein. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland Cement. Materials used in the manufacture of concrete brick shall meet the requirements of the following subsections:

Portland Cement	701-01
Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground, granulated blast-furnace slag may be substituted up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau. The nominal dimensions of the brick shall be 8 inches long, 4 inches wide, and 2 $\frac{2}{3}$  inches in height.

**Physical Properties.** Concrete brick shall meet the compressive strength and absorption requirements in ASTM C936. In addition, the maximum acceptable average freeze/thaw loss of five paver samples, subjected to 25 freeze/thaw cycles in a 10% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A total of 15 concrete bricks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with

ASTM C140. Five samples will be tested for freeze/thaw durability in accordance with NYSDOT test methods.

**BASIS OF ACCEPTANCE.** Concrete brick will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department's Approved List for the item being supplied.
- A manufacturer's certification.

An acceptable product evaluation made by the Engineer.

### **704-03 PRECAST CONCRETE - GENERAL**

**SCOPE.** This specification covers the general material and quality requirements for precast concrete items produced in accordance with the current Materials Procedure for precast concrete QC/QA titled "Procedures For Achieving And Maintaining Precast Concrete Manufacturer's Approved List Status". It is intended for use in conjunction with the individual item specifications.

**MATERIAL REQUIREMENTS.** The Portland Cement Concrete shall meet the requirements in §501, Portland Cement Concrete - General; §501-2.02, §501-2.03 and §501-3.02 except as noted herein.

Type 1, 2 or 3 cement may be used. The manufacturer may substitute pozzolans up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Certain aggregates appear in the Approved List of Sources of Fine & Coarse Aggregates that have use limitations with a high alkali portland cement. When requested, the Materials Bureau may approve this combination when 15-20% by weight of the cement in the mix is replaced with fly ash.

The concrete shall have an air content of 5.0 to 9.0%. Unless noted otherwise in the contract documents, approved fabrication drawings or item specification, the minimum compressive strength of concrete used in precast units shall be 3000 psi @ 28 days.

Threaded inserts used to connect reinforcing steel to precast concrete shall be non-corrosive and shall have a tensile capacity of at least 50% of the yield strength of the reinforcing steel.

The use of galvanized reinforcing in place of specified epoxy coated reinforcing is allowed. If galvanized reinforcing is used, all reinforcing in the unit must be galvanized. The use of galvanized dowels to attach secondary pours, requires all reinforcing in secondary pours to be galvanized. When galvanized wire fabric for concrete reinforcement is used, it shall be galvanized in accordance with ASTM A123. Fabrication, including bending of fabric, shall be performed prior to galvanizing.

Additional materials, listed below, shall meet the requirements of the following subsections:

Concrete Repair Material	701-04
Concrete Repair Material - High Early Strength	701-12
Bar Reinforcement, Grade 60	709-01
Wire Fabric For Concrete Reinforcement	709-02
Epoxy Coated Bar Reinforcement, Grade 60	709-04
Epoxy Coated Wire Fabric Reinforcement	709-08
Cold-Drawn Wire For Concrete Reinforcement	709-09
Mechanical Connectors for Reinforcing Bar Splices (Epoxy Coated)	709-10
Galvanized Bar Reinforcement	709-11
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Polyethylene Curing Covers (White Opaque)	711-04
Membrane Curing Compound (Clear w/Fugitive Dye)	711-05
Burlap	711-06
Corrosion Inhibitor	711-13

**DRAWINGS.** Precast concrete units shall be fabricated to conform to the details contained in the plans and contract documents. Fabrication Drawings shall be one of the following:

**A. Contract Plan Sheets.** When the contract plans contain enough detail to properly fabricate and inspect the precast element they may be used as the fabrication drawings. The Materials Bureau will determine whether or not the contract plans contain enough detail.

**B. Department Standard Sheets.** When Department Standard Sheets are referenced in, and are in compliance with the contract plans, the Standard Sheet shall be used as the fabrication drawing.

**C. Fabricator Working Drawings.** When the contract plans do not contain enough detail to be used as fabrication drawings and there is no Department Standard Sheet for the precast element or the Standard Sheet is not in compliance with the contract plans, Fabricator Working Drawings shall be used as the fabrication drawings.

**D. Fabricator Standard Drawing.** Fabricator Standard Drawings, previously approved by the Director, Materials Bureau, which meet the requirements of the contract plans, may be used as the fabrication drawings in place of Contract Plan Sheets, Department Standard Sheets or Fabricator Working Drawings.

Fabrication Drawings shall be prepared and processed in accordance with the current Materials Procedure for Preparing And Processing Fabrication Drawings For Precast Concrete Products.

**FABRICATION.** The manufacturer shall produce precast units that conform to the details of the approved fabrication drawings. The precast units shall be uniform in appearance. All concrete surfaces which will be exposed to view after installation shall be flat and smooth, free from irregularities and uniform in color and texture. The Department, and its representatives, shall have free access to the manufacturing facility and all products produced for the Department.

**Formwork.** Concrete shall be cast in rigidly constructed forms which will maintain the units within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of mortar. When wood forms are used all faces in contact with the concrete shall be laminated with a non-absorbent material. All worn or damaged forms which cause irregularities on the concrete surface or damage to the concrete during form removal shall be repaired or replaced before being reused. Form coatings, appearing on the Department's Approved List, shall be applied to all forms.

**Lifting Devices.** Lifting devices shall be a recessed type designed for use in precast concrete. The precast manufacturer shall ensure that the lifting devices selected for use have an adequate capacity to safely handle the precast product. Reinforcing steel shall not be used as a lifting device. Lifting devices that are used for turning or rotating a unit at the precast facility but are not necessary for further handling or installation shall be filled with concrete repair material before the unit is shipped. All other lifting devices shall be filled with concrete repair material after the unit is installed.

**Reinforcing.** Shall meet the requirements in §556, Reinforcing Steel for Concrete Structures; §556-3.01B and C, §556-3.02A and §556-3.03A through §556-3.03C. Unless noted otherwise in approved fabrication drawings or item specification, the minimum concrete cover over reinforcing steel shall be 1 1/2 inch. Reinforcing steel shall be tied and supported to keep it in position during the concrete placement. The ends of chairs or spacers, used to support or locate reinforcing steel, that bear on the faces of forms, shall be made of, or coated with, non-corrosive material so that no discoloration will show on the face of the units. Chairs, tie wires and other devices used to support, position or fasten epoxy coated or galvanized reinforcement shall be made of or coated with a dielectric material. Tack welding or

any other welding of specified steel reinforcement will not be allowed. Welding for cage stability will be permitted provided that redundant steel is added in each direction and tied to the cage. The redundant steel shall be thirty (30) bar diameters, minimum, in length and shall be positioned so that the midpoint is located at the weld.

**Corrosion Inhibitor.** When allowed by the individual item specification, corrosion inhibitor may be used in lieu of epoxy coated reinforcing. When corrosion inhibitor is selected for use it shall be clearly noted on the fabricator working drawing or in the fabrication request when standard sheets, contract plan sheets, etc are used as the fabrication drawings. When selected for use, corrosion inhibitor shall be used in all units produced to the referenced fabrication drawings. The corrosion inhibitor shall be added to the concrete as an aqueous solution at a dosage rate of 4 gal/cy.

The calcium nitrite, which acts as an accelerator, may be used in conjunction with compatible retarding admixtures to control setting time and workability of the concrete, however the use of a formulation of calcium nitrite solution which includes a set control ingredient may be used if setting times and increased water demands are of concern, consult the manufacturer of the product. The corrosion inhibitor must be added to the mix immediately after air entraining and retarding admixtures have been introduced into the batch.

When a batching problem exists or is perceived the Department reserves the right to test the hardened concrete at any time to verify the quantity of calcium nitrite present. Units with less than the specified amount of calcium nitrite shall be subject to rejection. If hardened concrete is tested, 4 inches diameter cores shall be drilled by the manufacturer under the supervision of a Department representative. Cores shall be a minimum of 4 inches in length unless otherwise approved by the Materials Bureau. Core holes shall be plugged and repaired in accordance with the requirements of repair indicated below.

**Concrete Placement And Consolidation.** Suitable means shall be used for placing concrete to prevent segregation. The concrete shall be thoroughly consolidated by external or internal vibrators or a combination of both, unless otherwise approved by the Materials Bureau. Vibrators shall not be used to move concrete within the forms. Concrete shall be placed and consolidated in a way that minimizes the presence of surface voids or bug holes on the formed surfaces.

**Cold Weather.** When concrete is cast in ambient temperatures less than 50°F the following requirements shall apply:

- A. Immediately before concrete placement the minimum temperature inside the forms shall be 40°F.
- B. Immediately following completion of the placement the requirements of the chosen curing method shall be followed.
- C. Concrete temperatures required by the chosen curing method shall be maintained by means of an external indirect heat supply or by utilizing the heat of hydration. Curing temperatures shall not exceed 85°F unless units are steam cured in accordance with this specification. When an external heat supply is used the enclosure shall be properly vented to prevent surface disintegration of the fresh concrete due to an accumulation of carbon dioxide gas.
- D. The plastic concrete shall not be exposed to freezing temperatures after it has been placed into the forms or during the curing period.

**Dimensional Tolerances.** The following tolerances shall apply, unless noted otherwise in the contract documents, approved fabrication drawings or item specification:

- Unit dimensions ±1/2 inch
- Variations in required spacing of reinforcing steel, not cumulative. ±2 inches
- Concrete cover over reinforcing steel +5/8 inch  
-1/4 inch



- All reinforcing steel fabrication tolerances shall conform to ACI 117 sec 2.1.
- All reinforcing steel embedded and lap length tolerances shall conform to ACI 117 sec 2.2.8.

The application of fabrication tolerances shall not impact the proper fit, alignment or function of the assembled precast item, nor shall it negatively impact the appearance of precast items which are exposed to view after installation.

## **Architectural Treatments**

**A. Architectural Patterned And Textured Precast Concrete.** The architectural pattern or textured effect called for in the contract plans shall be obtained by using form liners, stamping equipment or other texturing tools recommended by the manufacturer. Details of the architectural pattern or texture and the fabrication method used shall be shown on the fabrication drawings for the precast item. Concrete surfaces treated with form liners or by stamping shall have a repeatable, seamless pattern such that when installed the units will form a continuous, natural looking, matching and repeatable pattern. Surfaces treated with texturing tools shall be uniform in appearance. When form liners are used, a high quality release agent compatible with the form liner material shall be used. Form liners which are worn or damaged resulting in a non-uniform appearance or damage to the concrete during form removal shall be replaced. Fabrication drawings shall clearly show the design thickness of the precast element and the thickness being added by the architectural pattern or texturing. The architectural pattern or texturing shall not penetrate into the required concrete cover over the reinforcing steel at any point.

**B. Exposed Aggregate Precast Concrete.** Coarse aggregate shall meet the color and size requirements in the plans. When no size is specified a Type CA1 gradation, or equal approved by the Director, Materials Bureau, shall be used. A set retarder designed for use in exposed aggregate applications shall be used. Surfaces requiring an exposed aggregate finish shall be uniform in appearance with the surface completely covered with exposed aggregate. A set retarder shall be applied, in accordance with the manufacturers recommendations, to the surfaces receiving the exposed aggregate finish. Alternate methods of obtaining the exposed aggregate finish require prior approval of the Director, Materials Bureau. Unless otherwise shown in the contract plans, the depth of exposure shall be 30% of the primary size of the coarse aggregate. The depth of exposure shall be measured by laying a straight edge across the plane of the concrete face and measuring back to the concrete matrix.

**C. Integral Coloring.** Integrally colored concrete shall be produced by use of a pigment coloring system meeting the requirements of ASTM C979. For each color used the pigment shall be from the same batch or lot unless otherwise approved by the Director, Materials Bureau. Pigment will be approved based on a manufacturers certification of compliance with these requirements. Type 6 white cement, meeting the requirements of §701-01, may be used to achieve the desired color. Coloring pigment shall be added to the concrete mix per manufacturer's recommendations, at a dosage rate to achieve the desired color as specified in the contract documents. The manufacturer's recommended maximum dosage rate shall not be exceeded.

**D. Visual Standards.** The Contractor shall construct visual samples that are the same general size and shape as the production units they represent. The samples must be submitted to the Regional Landscape Architect for written approval. Each of the patterns, textures and colors identified in the plans shall be represented by the samples. Only one pattern or texture shall be used per sample face. When multiple patterns or textures are called for, additional samples will be required. Materials and fabrication techniques used in the samples, including curing, concrete pigment and sealers, shall be the actual materials and techniques to be used in the construction of the final product. If the samples

are rejected by the Landscape Architect, the Contractor shall construct additional samples as required to obtain the Landscape Architect's approval. The approved samples shall be made available at the precast plant, for use by the inspector as visual standards, throughout production of the units. When surface coatings are to be field applied additional samples, without the surface coatings, shall be prepared and retained at the precast plant for use as visual standards. The fabrication of precast concrete units shall not begin until written approval of the visual standards has been received from the Department.

**E. Visual Evaluation.** When comparing production units against the visual standards there shall be minimal color and texture variations, from the standard, when viewed in good typical lighting at a 20 foot distance. When viewed alone, production units shall show no obvious imperfections or evidence of repairs other than minimal color and texture variations when viewed in good typical lighting at a 20 foot distance.

**Curing.** All precast concrete units shall be subjected to curing by any one of the methods described in the following paragraphs. The manufacturer shall provide minimum/maximum temperature thermometers to monitor curing temperatures unless otherwise specified. If, at any time, curing temperatures fall below the specified minimum for the chosen curing procedure, the curing period shall be increased accordingly.

Except as noted under D. Moisture Retention Curing, no unit shall be subjected to freezing temperatures until the following two conditions are met:

- The chosen curing cycle has been completed.
- The specified 28 day compressive strength or 3000 psi, whichever is less, has been reached.

Cylinders shall be cured in the same manner and maintained in the same temperature and environmental conditions as the units they represent until being tested.

**A. Steam Curing.** The units shall be cured in a suitable enclosure. The enclosure shall be designed to minimize the loss of heat and moisture while allowing for the uniform circulation of steam around the entire unit. The interior surfaces of the enclosure and the surface of the unit shall be moist at all times. Steps shall be taken to prevent localized "hot spots" caused by the steam lines. The enclosure shall be free from outside drafts.

Steam curing shall not begin until a preset period has been completed. The preset period begins when the last concrete has been placed and continues until the concrete obtains initial set. Prior written approval from the Director, Materials Bureau is required when preset periods of less than two hours are to be used. During the preset period, moderate heat may be applied to the enclosure to maintain the initial temperature of the concrete. The maximum temperature inside the enclosure during the preset period shall be the initial temperature of the concrete +10°F.

After the preset period is complete, steam shall be injected into the curing enclosure. The temperature inside the enclosure shall not be increased at a rate greater than 40°F per hour. A moist atmosphere shall be maintained at a temperature between 105°F and 185°F for a period of not less than 12 hours. The temperature inside the enclosure shall then be decreased at a rate not exceeding 40°F per hour until the ambient temperature outside the enclosure is reached. The manufacturer shall provide automatic temperature recorders to continuously record the curing temperature inside the enclosure.

**B. Water Spray Curing.** Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the water spray but not more than 2 hours after the completion of finishing. All exposed surfaces of the precast unit shall be kept wet with a continuous fine spray of water in an enclosure maintained at a temperature of not less than 70°F for a period of not less than 72 hours. Additional curing time may be necessary to meet the 28 day strength requirements.

**C. Saturated Cover Curing.** The saturated covers used under this method shall be burlap. Curing shall begin as soon as the concrete has hardened sufficiently to prevent surface damage from the saturated burlap but not more than 2 hours after the completion of finishing. All exposed concrete surfaces on the precast unit shall be covered with burlap, saturated with water before applying. The burlap shall be kept saturated and the units kept at a temperature of not less than 70°F for a period of not less than 72 hours. Additional curing time may be necessary to meet the 28 day strength requirements.

**D. Moisture Retention Curing.** Units cured in accordance with these methods shall be maintained at a temperature of not less than 45°F for a period of not less than 7 days except as noted below. Additional curing time may be necessary to meet the 28 day strength requirements. When the specified 28 day compressive strength or 3000 psi, whichever is less, has been reached the unit may be exposed to freezing temperatures however the membrane curing compound or curing covers must still be maintained for a minimum of 7 days.

**1. Membrane Curing Compound.** The membrane curing compounds used under this method must appear on the Department's current Approved List of Membrane Curing Compounds under B. Clear (with fugitive dye). The compound shall be properly agitated immediately before each use. A minimum coverage rate of one gallon per 150 square feet shall be used.

The membrane curing compound shall be applied to the concrete surface after finishing as soon as the free water on the surface has disappeared and no water sheen is visible, but not so late that the liquid curing compound will be absorbed into the concrete. When curing compound cannot be applied within the above requirements, the manufacturer shall instead immediately begin curing the unit in accordance with one of the other curing methods contained in this specification, until curing compound can be applied.

If the forms are left on for a minimum of 7 days, curing compound is not required on any formed surfaces. When the forms are removed prior to 7 days, the exposed concrete surfaces shall be wet with water within one half hour of form removal and shall be kept moist until the curing compound is applied. Before application, the concrete shall be allowed to reach a uniformly damp appearance with no free water on the surface and then the compound shall be applied immediately.

This method of curing shall not be used on any concrete surface which is to have plastic concrete, grout or mortar bonded to it or on any concrete surface that will have a penetrating or coating type treatment such as a sealer or stain applied to it. Another approved method of curing shall be used when this condition exists.

**2. Curing Covers.** The curing covers used under this method shall be either Plastic Coated Fiber Blankets, §711-03, appearing on the Department's Approved List or Polyethylene Curing Covers meeting the requirements of §711-04. Curing covers shall be placed immediately following the finishing operation or form removal, whichever is applicable. Care shall be taken not to damage any exposed concrete surfaces during cover placement. Curing covers shall be placed and secured and be of such condition as to minimize the loss of moisture and temperature. When it is necessary to use more than one curing cover the edges shall be lapped a minimum of 12 inches.

**E. Other Methods.** Other Methods of curing are subject to approval by the Director, Materials Bureau.

**Repair.** Precast concrete units that contain minor defects caused by manufacture or mishandling shall be repaired at the manufacturing site. In addition, units that contain minor defects caused by mishandling during shipment or installation shall be repaired at the project site. When repairs are made to a unit that

has been sprayed with curing compound, the compound must be removed from the repair area before making the repair as it will act as a bond breaker between the precast concrete and the repair material. Major defects and non repairable defects in a unit will be cause for rejection of the unit. Defects are defined as follows:

**A. Surface Defects.** Surface voids or bugholes which are less than 5/8 inch in diameter and less than 1/4 inch deep are acceptable, except as noted under D. of this section. Surface defects need not be repaired.

**B. Minor Defects.** Minor defects are defined as: spalls, honeycombing and surface voids which have no dimension greater than 12 inches, when measured along a straight line, and do not expose the reinforcing steel. Minor defects shall be repaired by removing all unsound concrete from the defect, square cutting the edges of the defect to prevent feather edging of the repair and then filling the void with concrete repair material meeting the requirements of §701-04 or §701-12. Concrete repair material shall have a color similar to that of the precast unit. The repair shall be finished to the proper shape and cured in accordance with the repair material manufacturer's recommendations. It shall withstand a moderate blow with a 16 oz hammer. The blow shall produce a sharp ring indicating proper bonding of the repair.

**C. Major Defects.** Major defects are defined as: spalls, honeycombing and surface voids which have any dimension greater than 12 inches, when measured along a straight line, or expose the reinforcing steel. Cracks which go through the section or are greater than 0.01 inch in width are also major defects.

No major defect shall be repaired without prior approval of the Department. Requests to repair major defects shall be made in accordance with the requirements contained in the current Materials Procedure for precast concrete.

**D. Non Repairable Defects.** Non repairable defects are defined as: cracks in a concrete surface, which will be exposed to view after installation, that are visible when viewed in good typical lighting with the naked eye at a 10 foot distance; minor defects which in total make up more than 5% of the surface area of the unit and excessive surface defects on more than 5% of the surface area which will be exposed to view after installation.

**SAMPLING AND TESTING.** Sampling and testing shall be done by the precast manufacturer in accordance with Materials Bureau requirements contained in the current Materials Procedure for precast concrete.

**MARKING.** All precast units shall be clearly marked with permanent waterproof paint. Unless noted otherwise in the item specification, units shall be marked on an inside or back surface which will not be exposed to view after installation. The following information shall be included:

Name or trademark of the manufacturer.

Date of manufacture.

Unique piece identification number.

NYSDOT Contract number.

**FINAL PRODUCTION INSPECTION.** A final production inspection shall be performed by the precast manufacturer on every precast unit produced for the Department. An inspection will be considered satisfactory when it verifies that the precast unit is in compliance with the appropriate Department specifications. The specific requirements and procedures for the inspection are contained in the precast manufacturer's Department approved Quality Control Plan.

**SHIPPING.** Upon completion of a satisfactory final production inspection the precast unit may be shipped from the manufacturing location except that units produced between the dates of October 31st and April 1st shall not be shipped for a minimum of 72 hours following the completion of casting.

**BASIS OF ACCEPTANCE.** Precast units will be accepted at the job site based on the following:  
The manufacturer's name must appear on the Department's Approved List for the item being supplied.  
A manufacturer's certification.  
An acceptable product evaluation made by the Engineer.

#### **704-04 CONCRETE BLOCK (SLOPE PAVING)**

**SCOPE.** This specification covers the material details and quality requirements for concrete block for use in concrete block slope paving and produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled "Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status".

**MATERIAL REQUIREMENTS.** Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland Cement. Materials used in the manufacture of concrete block shall meet the requirements of the following subsections:

Portland Cement	701-01
Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground granulated blast furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**Physical Properties.** The minimum acceptable average compressive strength of five-block samples is 6000 psi, with no individual block less than 5500 psi. The maximum acceptable average freeze/thaw loss of five-block samples, subjected to 42 freeze/thaw cycles in a 3% NaCl solution, shall not exceed 1.0%, with no individual sample exceeding 1.5%.

Block dimensions shall be as required in the contract documents. Dimensions shall not vary by more than 1/4 inch from those specified. Blocks shall be sound and free from cracks or other defects that would interfere with their proper placement or performance.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A minimum of five samples, prepared by the manufacturer in accordance with ASTM C1262, will be required for freeze/thaw testing.

Samples will be tested for compressive strength in accordance with ASTM C140. Samples will be tested for freeze/thaw durability in accordance with ASTM C1262.

**BASIS OF ACCEPTANCE.** Concrete block will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department's Approved List for the item being

supplied.

- A manufacturer's certification.

An acceptable product evaluation made by the Engineer.

#### **704-05 PRECAST CONCRETE BARRIER**

**SCOPE.** This specification covers the material and quality requirements for precast concrete barrier used in highway applications, precast concrete barrier for structures, and precast temporary concrete barrier.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete mixtures used under this specification shall have a maximum cement content of 750 lbs per cubic yard. Unless noted otherwise in the contract documents or approved fabrication drawings, the compressive strength of concrete used in precast concrete barrier shall be as follows:

Concrete Barrier	3,000 psi (minimum) @ 28 days
Concrete Barrier for Structures	5,000 psi (minimum) @ 28 days
Temporary Concrete Barrier	3,000 psi (minimum) @ 28 days

All reinforcing steel for Concrete Barrier and Concrete Barrier For Structures shall be epoxy coated meeting the requirements of 709-04 Epoxy Coated Bar Reinforcement, Grade 60. All reinforcing steel for Temporary Concrete Barrier shall meet the requirements of 709-01 Bar Reinforcement, Grade 60.

**DRAWINGS.** The drawing requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete Barrier and Temporary Concrete Barrier shall use dimensions as shown on the Standard Sheets. Concrete Barrier for Structures shall use dimensions as shown on the Bridge Design (BD) Sheets.

**FABRICATION.** The fabrication requirements contained in 704-03 Precast Concrete - General, as well as the following shall apply.

- Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
- Barrier shall not be out of plumb by more than 1/4 inch.
- Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 feet of barrier.
- When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in 704-03 Precast Concrete - General shall apply.

**MARKING.** The Marking requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete Barrier and Concrete Barrier For Structures shall be marked on one end of each barrier segment such that they will not be exposed to view after installation.

Temporary Concrete Barrier shall be marked with "NYS DOT" in place of a Department contract number. In addition, each Temporary Concrete Barrier segment shall be permanently marked with a manufacturer's identification and a date of manufacture in a manner that will remain legible throughout its service life. The date, at a minimum, shall contain the month and year. Permanent markings shall be placed in a consistent location on the top, bottom, or one end of each segment. Imprinting the required information a minimum of 1/4 inch into the concrete surface will be considered an acceptable permanent

marking. Paint will not be considered a permanent marking. If permanent markings are located on the bottom of the segment, paint markings matching the permanent markings shall be placed on one end of each segment to facilitate field inspection.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in 704-03 Precast Concrete - General shall apply.

**SHIPPING.** The Shipping requirements in 704-03 Precast Concrete - General shall apply.

**BASIS OF APPROVAL.** Designs for permanent, standard Concrete Barrier other than those shown on the Standard Sheets will not be approved.

Concrete Barrier for Structures designs may be proposed, and if found acceptable, will be placed on the Approved List. Evidence shall be provided that the proposed anchorage system has been successfully tested in accordance with the procedural directives issued by the DCES.

Temporary Concrete Barrier designs other than those shown on the Standard Sheets may be proposed, and if found acceptable, will be placed on the appropriate Approved List based on their deflection and fixity (pinned or unpinned). Evidence shall be provided that the temporary concrete barrier, with the proposed joint system and anchorage, is MASH compliant. Additionally, the submitted design must include details of a barrier segment that can connect between the proposed system and NYSDOT's generic Temporary Concrete Barrier.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 Precast Concrete - General shall apply.

#### **704-06 PRECAST CONCRETE WALL UNITS AND PRECAST CONCRETE CRIBBING**

**SCOPE.** This specification covers the material and fabrication requirements of precast concrete wall units and precast concrete cribbing for prefabricated wall systems.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03 shall apply.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

#### **704-07 DRY CAST CONCRETE WALL UNITS**

**SCOPE.** This specification covers the material details and quality requirements for dry cast concrete wall units produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled “Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status”.

**MATERIAL REQUIREMENTS.** Provide dry cast concrete wall units meeting the style and color requirements in the contract documents. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland cement. Use materials, meeting the following requirements, in the manufacture of dry cast concrete wall units:

Portland Cement	701-01
Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Use integral coloring pigments, when required, meeting the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**Physical Properties.** The minimum acceptable average compressive strength of five-block samples is 6000 psi, with no individual block sample less than 5500 psi. The maximum acceptable average freeze/thaw loss of five-block samples, subjected to 42 freeze/thaw cycles in a 3% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

The formed dimensions of dry cast concrete wall units will not differ more than ¼ inch from the nominal dimensions shown on the approved Materials Detail Drawing. Provide sound blocks, free from cracks or other defects that would interfere with the proper placing, performance, or appearance of the blocks.

**Materials Details.** At the time of application to the Approved List, submit Materials Details Drawings to the Director, Materials Bureau for approval. Prepare and submit drawings in accordance with Departmental procedural directives. Submit a unique drawing(s) for each block style under consideration.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A minimum of 5 samples, prepared by the manufacturer in accordance with ASTM C140, will be required for compression testing. A minimum of five samples, prepared by the manufacturer in accordance with ASTM C1262, will be required for freeze/thaw testing.

Samples will be tested for compressive strength in accordance with ASTM C140. Samples will be tested for freeze/thaw durability in accordance with ASTM C1262.

**BASIS OF ACCEPTANCE.** Dry cast concrete wall units will be accepted on the job site based on the following:

- The manufacturer's name and block style must appear on the Department’s Approved List for the item being supplied.
- A manufacturer’s certification.
- Conformance to the approved material detail drawing(s).

An acceptable product evaluation made by the Engineer.



## **704-08 BRICK SIDEWALK AND DRIVEWAY PAVERS**

**SCOPE.** This specification covers the material and quality requirements for brick pavers made from extruded fire clay or shale for use in brick paving.

**MATERIAL REQUIREMENTS.** Brick pavers shall conform to the requirements of ASTM C902, Class SX, Type I. Brick pavers shall be the shape, size, and color shown in the contract documents.

**SAMPLING AND TESTING.** Samples, when requested by the Department, shall be randomly selected from production-run material. A minimum of 10 full-size bricks of the same size and style will be required. Samples will be tested for the physical properties identified in ASTM C902. Tests will be performed in accordance with ASTM C67.

**BASIS OF ACCEPTANCE.** Brick sidewalk and driveway pavers will be accepted on the basis of a material certification that specifies the product conforms to this specification.

## **704-09 STONE BLOCKS**

**SCOPE.** This specification covers the material and quality requirements for stone blocks for use in Grouted Stone Block Paved Sidewalks and Driveways.

**MATERIAL REQUIREMENTS.** Stone blocks shall be new or used granite or other stone as specified.

The blocks shall be sound and durable, reasonably uniform in quality and texture throughout, free from shale, excess mica, seams, scaling or evidence of disintegration. Color shall be as specified.

Samples of stone blocks shall be submitted to and be approved by the Engineer prior to beginning of work.

The blocks shall be rectangular in shape, with the following approximate dimensions: 8 - 12 inches in length, 3 - 5 inches in depth, unless otherwise specified or approved, and so dressed that they may be laid with a maximum of 1 1/4 inch joints or as specified. All blocks shall have one reasonably smooth split face with no projections or depressions over 1/4 inch. Cutting of blocks to meet the pattern requirements will be permitted subject to the approval of the Engineer.

**BASIS OF ACCEPTANCE.** Stone blocks shall be inspected, by the Engineer, for dimensional and color compliance upon arrival at the project location. Blocks not in compliance with the contract documents may be rejected by the Engineer.

## **704-10 SPLIT-FACED CONCRETE BRICK**

**SCOPE.** This specification covers the material details and quality requirements for split faced concrete brick for use in facing structural walls and produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled "Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status".

**MATERIAL REQUIREMENTS.** Split-faced concrete brick shall conform to the requirements of ASTM C90, except as noted herein. The shape, size, and color of split-faced concrete brick shall be as shown in the contract documents. The splitting operation shall leave relatively sharp, straight and parallel edges. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland Cement. Materials used in the manufacture of split-faced concrete brick shall meet the requirements of the following subsections:

Portland Cement

701-01

Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A minimum of 10 full-size, split-faced bricks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140.

The manufacturer shall be responsible for having brick tested for linear drying shrinkage in accordance with ASTM C90. A copy of the test report shall be included with the samples submitted to the Department for compression and absorption testing.

**BASIS OF ACCEPTANCE.** Split-faced concrete brick will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department's Approved List for the item being supplied.
- A manufacturer's certification.

An acceptable product evaluation made by the Engineer.

#### **704-11 PRECAST CONCRETE COPING**

**SCOPE.** This specification covers the material and quality requirements for precast concrete coping.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03 shall apply except as noted herein.

Coping shall be produced with a dense, smooth, uniform finished surface without rubbing or additional treatment. Corners shall have a maximum radius of 1/8 inch and grinding will not be allowed. Coping shall be removed from the forms and handled in a manner that will prevent chipping of the edges and faces of the concrete.

**Repair.** Surface defects, regardless of size, shall be repaired by wetting the surface to achieve a damp condition with no standing water in the holes and then filling the holes with a mortar composed of an appropriate proportion of sand and cement having the same color and physical characteristics of the original mix. The mortar shall be allowed to partially harden and then be rubbed until a clean, uniform appearance, with no visible coating of mortar on the concrete, is obtained. The mortar repair shall be cured in the same manner as the coping unit.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on one end of each unit such that they won't be exposed to view after installation.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

## **704-12 CONCRETE BLOCK**

**SCOPE.** This specification covers the material and quality requirements for concrete block for use in structural walls and produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled "Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status".

**MATERIAL REQUIREMENTS.** Concrete block shall conform to the requirements of ASTM C90 except as noted herein. The shape, size, and color of concrete block shall be as shown in the contract documents. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland Cement. Materials used in the manufacture of concrete block shall meet the requirements of the following subsections:

Portland Cement	701-01
Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A minimum of 10 full-size concrete blocks of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140.

The manufacturer shall be responsible for having block tested for linear drying shrinkage in accordance with ASTM C90. A copy of the test report shall be included with the samples submitted to the Department for compression and absorption testing.

**BASIS OF ACCEPTANCE.** Concrete block will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department's Approved List for the item being

supplied.

- A manufacturer's certification.
- An acceptable product evaluation made by the Engineer.

#### **704-13 PRECAST CONCRETE DRIVEWAY AND SIDEWALK PAVERS**

**SCOPE.** This specification covers the material details and quality requirements for precast concrete pavers used for driveway and sidewalk paving and produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled "Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status".

**MATERIAL REQUIREMENTS.** Precast concrete pavers shall meet the requirements of ASTM C936 except as noted herein. The shape, size, and color of precast concrete pavers shall be as shown in the Contract documents. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland Cement. Materials used in the manufacture of precast concrete pavers shall meet the requirements of the following subsections:

Portland Cement	701-01
Coarse Aggregate	703-02
Mortar Sand	703-03
Grout Sand	703-04
Concrete Sand	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

Fly ash or ground, granulated blast-furnace slag may be substituted for up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**Physical Properties.** Precast concrete pavers shall meet the compressive strength and absorption requirements of ASTM C936. In addition, the maximum acceptable average freeze/thaw loss of five paver samples, subjected to 25 freeze/thaw cycles in a 10% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A total of 15 precast concrete pavers of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140. Five samples will be tested for freeze/thaw durability in accordance with NYSDOT test methods.

**BASIS OF ACCEPTANCE.** Precast concrete driveway and sidewalk pavers will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department's Approved List for the item being supplied.
- A manufacturer's certification.

An acceptable product evaluation made by the Engineer.

## 704-14 PRECAST CONCRETE PANEL UNITS (Mechanically Stabilized Earth System)

**SCOPE.** This specification covers the material and quality requirements for precast concrete panel units used to construct a mechanically stabilized earth system.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein.

Unless noted otherwise in the contract documents or approved fabrication drawings the concrete used to fabricate panel units shall have a minimum compressive strength of 5000 psi @ 28 days.

Reinforcing steel shall be epoxy coated meeting the requirements of §709-04 or §709-08.

Embedded items shall be as detailed on the fabrication drawings. Acceptance of embedded items will be based on manufacturer's certification, unless otherwise directed by the Materials Bureau. When steel embedments are required, they shall be galvanized to §719-01.

**DRAWINGS.** The drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following, shall apply.

**A. Corrosion Inhibitor.** When required in the contract plans the concrete used shall contain a corrosion inhibitor. The use of corrosion inhibitor does not replace the requirement for epoxy coated reinforcing.

### **B. Dimensional Tolerances**

- Panel dimensions (edge-to-edge of concrete). ±1/4 inch
- Panel thickness. ±1/4 inch
- Length difference between two diagonals (squareness). ±3/8 inch
- Distance between the centerline of dowel and dowel sleeve. ±1/4 inch
- Dimension from the face of panel to centerline of dowel and dowel sleeve, and to centerline of reinforcing steel. ±1/4 inch
- Warping of the exposed panel face 1/4 inch in 5 feet
- Location of tie strips. ±1 inch
- Location of coil embeds. ±1/4 inch
- Location of connection slots. ±1 inch
- Contact surfaces of each fabricated embedment assembly. ±1/8 inch from a straight line.
- Miscellaneous tolerances. as detailed on the fabrication drawings.

**C. Coating of Concrete Units.** When required in the contract plans, panel units shall be coated on all surfaces with a penetrating sealer meeting the requirements of §717-03 Penetrating Type Protective Sealers. Surfaces to be coated must be prepared by blast cleaning, removing all laitance, loose particles, etc. The surface shall be allowed to dry for 24 hours after wetting for any reason. All surface preparation work shall be completed before sealer application can commence. The coating of units shall take place prior to shipping unless otherwise approved by the Engineer.

Sealer materials shall not be applied during wet weather conditions. Any unit exposed to wetting within 12 hours of being sealed shall be recoated. Ambient and surface temperatures shall be a minimum of 40°F during application and until the sealed concrete is dry to the touch. Application by spray methods shall not be used during windy conditions.

The sealer shall be used as supplied by the manufacturer without thinning or alterations, unless specifically required in the manufacturer's instructions. Thorough mixing of the sealer before and

during use shall be accomplished as recommended by the manufacturer. Equipment for sealer application shall be clean of foreign materials. A minimum of two coats of sealer shall be applied. The total quantity of sealer applied by each coat shall be equal to the quantity required at the application rate specified in the Approved List. Each coat shall be allowed to dry before the next coat is applied. On sloping and vertical surfaces, sealer application shall progress from the bottom to the top. Care shall be taken to ensure that the entire surface of the concrete is covered and all pores filled.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

#### **704-15 PRECAST CONCRETE PAVEMENT SLAB SYSTEMS**

**SCOPE.** This specification covers material and fabrication requirements for precast concrete pavement slab systems. Approved systems can be supplied by any manufacturer appearing on the Department's Approved List entitled "Precast Concrete Manufacturers Approved for QC/QA Production – Groups 1 & 6," provided they obtain approval from the system designer.

**SYSTEM APPROVAL.** For Approved List consideration, the system designer must submit the following information to the Materials Bureau. After the Materials Bureau reviews the submitted information, the system designer will be required to perform a trial installation as detailed herein.

**A. Fabricator Standard Drawings.** Apply §704-03, Precast Concrete – General. Include the following details:

- Transverse joint support type, locations, spacing, and the mechanism used to transfer loads across transverse joints after slabs are placed.
- Longitudinal joint tie type, locations, spacing and the mechanism used to tie adjacent slabs together.
- Lifting insert type, location, positioning, and capping or backfill method.
- Grout port type, location, positioning, and capping or backfill method.

**B. Installation Instructions.** Provide installation instructions, including any special equipment, to address the following.

1. Subbase Preparation. Instructions for any recommended subbase preparation.
2. Slab Installation. Instructions for lifting, moving, protecting, lowering, and adjusting the slabs into position.
3. Bed and Level Slabs. Instructions to ensure slabs are fully supported by underlying layers at the correct line, grade, and cross slope while meeting contract smoothness requirements. Slabs may be either:

- Placed on a precisely graded bedding layer and grouted in-place to fill any small, isolated voids between the slabs and bedding layer (grade-supported).
- Placed or held near final position and jacked into place (grout-supported).
- Placed by other methods approved by the Director, Materials Bureau.

For grade-supported slabs, include all pertinent bedding and leveling instructions, including:

- Bedding material composition and gradation.
- Bedding grout mix design and anticipated strength gain. Bedding grouts must develop a minimum compressive strength of 600 psi in 12 hours.
- Method used to place the bedding material and grout beneath the slab.
- Method used to ensure complete bedding when placed.

For grout-supported slabs, include all pertinent bedding and leveling instructions, including:

- Material properties, composition, mix design, and anticipated strength gain of any slab-jacking material.
- Method used to place the slab-jacking material beneath the slab.
- Method used to ensure complete slab contact with jacking material when placed.

4. Backfilling Pavement Hardware. Instructions to completely encase load transfer devices, longitudinal joint ties, lifting inserts, and grout ports. Include all pertinent information, including:

- Material properties, composition, mix design, and anticipated strength gain of any backfill material that is not named in Backfill Material for Pavement Hardware, or, revised instructions for those materials if the manufacturer's instructions are not followed.
- Method used to place backfill material.
- Method used to ensure complete hardware encasement.

Subsequent to system approval, any change to approved installation instructions must be submitted to, and approved by, the Director, Materials Bureau, to maintain Approved List status. The Department reserves the right to require additional trial installations if the changes are deemed significant.

**C. Trial Installation.** Perform a trial installation at a facility agreeable to the Regional Materials Engineer that is within a 1-hour drive of a Regional Materials Laboratory. Ensure Materials Bureau and Regional Materials personnel are present. Place 4 (minimum) 12 x 12 foot slabs simulating 2 lanes of traffic. Provide a drill rig, with operator, capable of retrieving 4 inch diameter cores through any portion of the slab, and a technician capable of fabricating test specimens in accordance with Test Method NY 701-13P, C, Concrete Repair Material. As a minimum, the following will be evaluated:

1. Bedding Grout Properties and Completeness of Placement. Fabricate 24 cubes meeting Test Method NY 701-13P, C, Concrete Repair Material.
2. Leveling Material Properties and Completeness of Placement. Fabricate 24 cubes meeting Test Method NY 701-13P, C, Concrete Repair Material.
3. Backfill Material Properties and Completeness of Placement. If a material identified in this specification as Backfill Material for Pavement Hardware (under Material Requirements) is used in accordance with the manufacturer's written instructions, no further material testing is required. If a different material is used (or if a material is not used in accordance with the manufacturer's instructions), fabricate a sufficient amount of test specimens to determine the properties identified in Table 704-15-1, Backfill Material Requirements, when tested in accordance with Test Method NY 701-13P, C, Concrete Repair Material.
4. Dimensions and Tolerances. Slabs must conform to the Fabricator Standard Drawings and be capable of being placed in an essentially true plane.

5. Instruction Completeness. Manufacturer’s instructions must accurately reflect the processes used in the trial installation.
6. Load Transfer Efficiency (LTE). The Department reserves the right to conduct falling weight deflectometer testing to determine LTE at the joints. Poor LTE ( $\leq 70\%$ ) is cause for rejection.

**MATERIAL REQUIREMENTS.** Apply §704-03, Precast Concrete – General, except as noted herein.

**A. Concrete.** Use concrete having a minimum 28-day compressive strength of 4500 psi unless noted otherwise in the contract documents or approved fabrication drawings. Use aggregate meeting the friction requirements of Sections 501, Portland Cement Concrete – General, and 502, Portland Cement Concrete Pavement, for precast slabs that will remain concrete surfaced. Friction aggregate type is identified in the contract documents by pay item.

**B. Reinforcement.** Use bars meeting §709-04, Epoxy-Coated Bar Reinforcement, Grade 60. As a minimum, fabricate slabs with single-mat reinforcement located in the bottom third of the slab.

Provide 2 inch (minimum) concrete cover between the mat and the slab bottom. Fabricate mats using a size and spacing of steel (in both directions) that results in a steel area to cross-sectional area ratio of 0.0018 (minimum). Maximum bar spacing is 18 inches.

The manufacturer may provide additional reinforcement based on jobsite loading conditions. (A typical example is when slabs must be loaded before a bedding grout is placed.)

**C. Backfill Material for Pavement Hardware.** If the precast slab system requires a backfill material around pavement hardware, use DBR Retrofit Mortar, HD-50, Five Star Highway Patch, or an alternate prepackaged material submitted as an approved equal. If the brands named above are mixed in accordance with their manufacturer’s written instruction, no further testing is required. If the manufacturer’s written instructions are not followed, or if an alternate material is proposed for use, the material must meet Table 704-15-1, Backfill Material Requirements, when tested in accordance with Test Method NY 701-13P,C, Concrete Repair Material. Material submission instructions can be found at the Department’s web site, [www.nysdot.gov](http://www.nysdot.gov), under Approved List of Materials and Equipment Submission Instructions.

<b>TABLE 704-15-1 BACKFILL MATERIAL REQUIREMENTS</b>		
<b>Property</b>	<b>Minimum</b>	<b>Maximum</b>
Compressive Strength, Opening to Traffic	2500 psi	-
Compressive Strength, 28 Day	4000 psi	-
Expansion	-	0.40 %
Contraction	-	0.05 %
Freeze - Thaw Loss (25 cycles at 10% NaCl)	-	1.0 %
Bond Strength (to dry PCC)	300 psi	-
Initial Set Time	15 minutes	-
Chloride Content	-	0.05 %
Sulfate Content	-	5.0 %

**DRAWINGS.** Apply §704-03 Precast Concrete – General, except as noted herein. Provide job-specific Fabricator Working Drawings, from the system designer, for each contract. Use these drawings, in conjunction with approved Fabricator Standard Drawings, to manufacture the pavement slabs. Copies of approved working drawings will be returned to the system designer. If the manufacturer is not the system designer, include the manufacturer’s name, address, and telephone number on the drawings.



**FABRICATION.** Apply §704-03, Precast Concrete – General, except as noted herein.

**Texture.** Apply §502-3.10, Texturing, to the top surface of the slab.

**Curing.** When membrane curing compound is the selected curing method and the slabs are exposed to sunlight while curing, use a white pigmented membrane curing compound from the Department’s Approved List instead of a clear compound with fugitive dye.

**SAMPLING AND TESTING.** Apply §704-03, Precast Concrete - General.

**MARKING.** Apply §704-03, Precast Concrete - General.

**FINAL PRODUCTION INSPECTION.** Apply §704-03, Precast Concrete - General.

**SHIPPING.** Apply §704-03, Precast Concrete - General.

**BASIS OF ACCEPTANCE.** Apply §704-03, Precast Concrete – General, and the following:

- The system must appear on the Department’s Approved List entitled “Precast Concrete Pavement Slabs Systems (§704-15).”
- Written approval from the system designer to use the approved system if the manufacturer is not the system designer.

#### **704-16 THRU 704-22 FOR SITE MANAGER USE**

#### **704-23 PRECAST CONCRETE STREET PAVERS**

**SCOPE.** This specification covers the material and quality requirements for precast concrete pavers used for street paving and produced in accordance with the current Materials Procedure for Concrete Masonry QC/QA titled “Procedures for Achieving and Maintaining Concrete Masonry Units Approved List Status”.

**MATERIAL REQUIREMENTS.** Precast concrete pavers shall meet the requirements of ASTM C936 except as noted herein. The shape, size, and color of precast concrete pavers shall be as shown in the contract documents. Minimum thickness for precast concrete street pavers shall be 3 1/8 inches. Certain aggregates appear in the Approved List of Sources of Fine and Coarse Aggregates that have use limitations with high alkali Portland cement. Materials used in the manufacturing of precast concrete pavers shall meet the requirements of the following subsections:

Portland Cement	701-01
Coarse Aggregate*	703-02
Mortar Sand*	703-03
Grout Sand*	703-04
Concrete Sand*	703-07
Fly Ash	711-10
Ground, Granulated Blast-Furnace Slag	711-12
Water	712-01

\* **Aggregates.** For precast concrete pavers or equivalent products placed in concrete highway wearing surfaces, use aggregate from a source or sources on the “Approved List of Sources of Fine and Coarse

Aggregate.” All aggregate must be approved for use in concrete. Fine aggregate, natural or manufactured sand, must meet the requirements of §703-01, Fine Aggregate.

Crushed stone, crushed gravel, or crushed slag from a coarse aggregate source must meet the requirements of §703-02, Coarse Aggregate.

Aggregate friction requirements: Sample and test aggregate for friction characteristics according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures”, PCC Sand. The Engineer will identify pavement areas, if any, represented by failing samples according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures.”

Aggregate must contain at least 25.0% acid-insoluble residue in the plus No. 30 size fraction and in the minus No. 30, plus No. 200 size fraction. If more than one source of aggregate is used, aggregate from each source must meet the acid-insoluble residue requirements.

Fly ash or ground, granulated blast-furnace slag may be substituted up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix. Pigments used for integral coloring shall meet the requirements of ASTM C979. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

**Physical Properties.** Precast concrete pavers shall meet the compressive strength and absorption requirements of ASTM C936. In addition, the maximum acceptable average freeze/thaw loss of five paver samples, subjected to 25 freeze/thaw cycles in a 10% NaCl solution, is 1.0%, with no individual sample exceeding 1.5%.

**SAMPLING AND TESTING.** When samples are requested by the Department, they will be randomly selected from production-run material. A total of 15 precast concrete pavers of the same size and style will be required. Five samples will be tested for compressive strength and five for absorption, in accordance with ASTM C140. Five samples will be tested for freeze/thaw durability in accordance with NYSDOT test methods.

**BASIS OF ACCEPTANCE.** Precast Concrete Street pavers will be accepted on the job site based on the following:

- The manufacturer's name must appear on the Department’s Approved List for the item being supplied.
- A manufacturer’s certification.

An acceptable product evaluation made by the Engineer.

## **704-24 PRECAST CONCRETE PANELS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete panels.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03 shall apply.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

#### **704-99 FOR SITE MANAGER USE**

### **SECTION 705 - JOINT MATERIALS**

(Last Revised January, 2020)

#### **705-01 PREFORMED CORK JOINT FILLER**

**SCOPE.** This specification contains the material requirements pertaining to preformed cork joint filler.

**GENERAL.** The Joint Filler shall be of the dimensions shown on the plans or listed in the specifications. Each piece shall be plainly marked with the manufacturer's name.

**MATERIAL REQUIREMENTS.** Preformed Cork Joint Filler shall conform to the requirements of ASTM D1752, Type III (Self-expanding Cork).

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

#### **705-02 HIGHWAY JOINT SEALANTS**

**SCOPE.** This specification covers the material requirements for highway joint sealants. Highway joint sealants are hot-applied joint and crack sealants for use in sealing joints and cracks in Portland Cement Concrete (PCC) and Asphalt (HMA) pavements.

**MATERIAL REQUIREMENTS.** Highway joint sealants must meet the following requirements:

1. The material shall be tested by the National Transportation Product Evaluation Program (NTPEP) for joint and crack sealants for PCC and HMA pavements in accordance with their procedures.
2. ASTM D6690, Type II or Type IV.

**BASIS OF APPROVAL.** The approval of highway joint sealants shall be based upon satisfactory test results from the National Transportation Product Evaluation Program (NTPEP). Upon approval by the Materials Bureau, the joint sealant's brand, supplier's name and location will be placed on the Approved List. Resubmittal to NTPEP for product testing of a previously approved product is required every three years. The field testing of the product will not be required for resubmittal samples to NTPEP.

**BASIS OF ACCEPTANCE.** The highway joint sealant will be accepted based on the product appearing on the Approved List for the appropriate sealant class and the manufacturer's certification.

#### **705-03 PREFORMED RUBBER JOINT FILLER**

**SCOPE.** This specification contains the material requirements pertaining to preformed rubber joint filler.

**GENERAL.** The joint filler shall be of the dimensions shown on the plans or in the specifications.

**MATERIAL REQUIREMENTS.** Preformed Rubber Joint Filler shall conform to the requirements of the Standard Specifications for ASTM D1752, Type (Sponge Rubber), except that the use of reclaimed rubber or factice will be permitted.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

#### 705-04 VACANT

#### 705-05 SILICONE JOINT SEALANTS FOR PAVEMENTS

**SCOPE.** This specification covers the material requirements for silicone joint sealants for pavements.

**GENERAL.** Use equipment meeting §502-2.04 J, Joint Sealing (Silicone). Install the sealant in accordance with the manufacturer's written instructions.

**MATERIAL REQUIREMENTS.** Silicone Joint Sealant shall conform to the following requirements:

Property	Test Method	Specification ASTM D5893
Tack-Free Time, min.	ASTM C679	5 hrs. ± 10 min.
Accelerated Weathering	ASTM C793	Satisfactory
Flow	ASTM C639	No Flow
Modulus of Elongation	ASTM D412	600% (Minimum)
Bond, Non-Immersed	ASTM D5329	Satisfactory

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for Joint Materials, Pavement for Silicone Joint Sealants (705-05).

#### 705-06 CAULKING COMPOUND FOR STRUCTURES

**SCOPE.** This specification covers the material requirements for caulking compound for structures.

**GENERAL.** Caulking compound shall be applied with either a pneumatic or ratchet hand gun.

**MATERIAL REQUIREMENTS.** Caulking compound shall be a material which complies with Federal Specification TT-S-230 Sealing Compound, Synthetic-Rubber Base, Single Component, Chemically Curing. The color of the compound shall be cement mortar grey when tested in the manner described in TT-S-230 and compared against a color standard in possession of the Materials Bureau. This standard will be made available upon written request.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

#### 705-07 PREMOLDED RESILIENT JOINT FILLER

**SCOPE.** This specification contains the material requirements for premolded resilient joint filler.

**GENERAL.** The joint filler shall be of the dimensions shown on the plans or listed in the specifications. When the material is delivered cut to dimension, it shall be banded in bundles of convenient size.

**MATERIAL REQUIREMENTS.** The premolded resilient joint filler shall conform to the requirements of ASTM D1751. The asphalt content requirement may be waived if the material meets other requirements of D1751 based on supplementary testing performed by the Materials Bureau.

**BASIS OF ACCEPTANCE.** Application for approval of premolded resilient joint filler shall be submitted to the Director, Materials Bureau. Upon approval, the product name and its manufacturer will be placed on the Department's Approved List. Each lift or bundle of joint filler shall be tagged by the manufacturer; the product will be accepted at the work site on the basis of the name and manufacturer of the product appearing on the tag and the Approved List.

The Department reserves the right to sample and test the material after delivery at the project site.

**705-08 PREFORMED, CLOSED-CELL FOAM MATERIAL**

**SCOPE.** This specification covers the requirements for preformed, closed-cell foam material.

**MATERIAL REQUIREMENTS**

**General.** Closed-cell foam material is used primarily as the joint seal in structural expansion joint systems. The joint material shall remain unaffected by road salts and petroleum products. The material shall also be capable of maintaining a waterproof joint within the range of 50% compression and 25% tension. The joint material shall have grooves along the entire length of the bond surfaces for enhanced bonding performance. The grooves shall be 1/8 inch deep × 1/8 inch wide and spaced from 1/4 inch to 1/2 inch apart.

**Installation.** Install the preformed, closed-cell foam material according to the manufacturer's recommended procedure. If a bonding agent is required, it shall be one which is recommended by the manufacturer.

**Physical Properties.** The joint material shall be a closed-cell, cross linked, expanded polyethylene. Material will meet the properties of Table 705-1.

<b>TABLE 705-1</b>			
<b>Property</b>	<b>Test Method</b>	<b>Specification</b>	
		<b>Minimum</b>	<b>Maximum</b>
Extrusion	ASTM D545 @ 50% Compression 3 Sides Restrained	--	1/4 inch
Compression Deflection	ASTM D3575, Suffix D 50% Deflection @ 80°F	10 psi	60 psi
Density	ASTM D3575, Suffix W, Method A	2 pcf	3 pcf
Water Absorption	ASTM D545	--	3 %
Compression Set	ASTM D1056, 50% Deflection for 22 hrs. @ 70 ± 5°F	--	15% @ 168hrs.

**DIMENSIONS.** The joint material shall be of the thickness and width described in the contract

documents within a tolerance of +10% and -2%. Joint material shall be heat welded to the proper dimensions by the manufacturer. No glue or chemical agents shall be used to join pieces together. No laminations in width shall be allowed.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the product name appearing on the Department’s Approved List for Preformed Closed-Cell Foam Material.

**705-09 PREFORMED ELASTIC BRIDGE JOINT SEALER**

**SCOPE.** This specification covers the material requirements for preformed elastic bridge joint sealer for use in bridge joints.

**MATERIAL REQUIREMENTS.** The preformed elastic joint sealer material shall be vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer.

**Flexibility.** The sealer shape shall be capable of withstanding compression, rotation, or other joint movements without change in the position of the point of foldability, misalignment, or other conditions felt detrimental by the Director, Materials Bureau. The sealer shall exhibit sufficient sealing pressures throughout its expected compression range to assure that no deleterious materials enter the joint.

The joint sealer material shall be tested in accordance with AASHTO M297 except that Compression Deflection properties shall be determined in accordance with Department written instructions. Compression Deflection Properties, LC min and LC max, shall comply to that specified in Table 705-2. Test specimens shall be cut and/or buffed from joint seal samples.

<b>TABLE 705-2 COMPRESSION DEFLECTION PROPERTIES</b>		
<b>Nominal Seal Size (in.)</b>	<b>LC Min.%</b>	<b>LC Max.%</b>
3 or less	85	55
3 1/2	85	50
4	85	48
5	85	45
6	90	45

**DIMENSIONS.** The measured width and depth of joint seal material shall meet the minimum and maximum allowable dimensions as determined from the original drawings and the applied tolerances.

**Dimensional Tolerances.** The nominal height of the uncompressed sealer shall be greater than or equal to the nominal uncompressed width.

The measured width and height of joint material shall satisfy the minimum and maximum allowable dimensions as determined from the nominal dimensions shown on the approved drawings and the following dimensional tolerances.

A dimensional tolerance of ±5% of the nominal dimensions shall be applied to seals less than 4 inches in width. A dimensional tolerance of ±1/4 inch shall be applied to the nominal dimensions for seals greater than or equal to 4 inches in width.

**SERVICEABILITY**

**Installation and Performance Requirements.** Each lot of joint sealer submitted for Department approval shall demonstrate that it possesses the properties necessary for satisfactory field installation.

The sealer shall not exhibit any twisting, rolling, misalignment of opposite top edges, tendencies to

trap incompressibles or any other qualities which shall be deemed detrimental by the Department to the sealer's proper installation and performance.

**Joint Wall Contact with Sealer.** The top edges of the vertical walls shall remain in contact with the joint sealer faces throughout the compression range to which the sealer will be subjected in use.

**Lubricant.** The lubricant used to install the sealer shall conform to the requirements of '705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified in the proposal.

**BASIS OF ACCEPTANCE.** Preformed elastic bridge joint sealer will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

### **705-10 PREFORMED ELASTIC LONGITUDINAL JOINT SEAL**

**SCOPE.** This specification covers the material requirements for preformed elastic joint seal for use in longitudinal concrete pavement joints.

**GENERAL.** The preformed elastic material shall be a vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The shape of any joint seal shall be approved by the Director of the Materials Bureau prior to the submission of any individual production lot for approval.

Such approval shall be requested in writing and be accompanied by a detailed drawing of the shape and a 1.5 foot length of the proposed seal. The lubricant used to install the joint seal shall conform to 705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified.

### **MATERIAL REQUIREMENTS**

**Physical Requirements.** The joint seal material shall be tested in accordance with AASHTO M220 and meet the physical requirements therein. The requirements for compression-deflection, ozone resistance, and low-temperature recovery @ 14°F are waived.

The minimum percentage requirements for low-temperature recovery at -20°F, and for high temperature recovery at 212°F, shall be modified to 75%. Measurements for recovery may be made using an electronic caliper in addition to methods specified. The following exceptions shall be made to the recovery test when the seal shape has lips (a small protrusion on the top longitudinal edge). The seal shall be compressed to 50% of the nominal width of the seal. The denominator for the percent recovery calculation, however, shall be the width between the outer edges of the lips provided on the manufacturer's drawing. The numerator or recovered width shall be measured between the outer edges of the lips.

**BASIS OF ACCEPTANCE.** Preformed elastic longitudinal joint sealer will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **705-11 POLYVINYL CHLORIDE EXTRUDED SHAPES AND SHEET MATERIAL**

**SCOPE.** This specification covers the quality requirements for polyvinyl chloride extruded shapes and sheet material for use in expansion, contraction, construction joints and drainage troughs.

**GENERAL.** The PVC material from which the shapes shall be extruded shall not contain any reclaimed, reground or reworked material whatsoever, but shall be compounded from virgin PVC resins, plasticizers, stabilizers and such materials that when compounded it shall meet the physical requirements contained in this specification.

Material shall be extruded in such a manner that all cross sections shall be dense, homogeneous and free from porosity or other imperfections.

The dimensional tolerances shall be as shown on the plans.

All splices shall be heat welded as approved by the Engineer.

Each extrusion shall be plainly marked at 5 foot intervals with the manufacturer's name, lot number, and type.

**MATERIAL REQUIREMENTS.** The material for the extruded shapes shall meet the following performance requirements:

Property	ASTM Test Method	Requirement
Tensile strength, psi	D412, Die C	1400 min.
Ultimate elongation, percent	D412, Die C	250 min.
Hardness, Type A durometer	D2240 *	65-88
Resistance to alkali	D543 **	-
Weight change, percent	-	-0.10 to +0.25
Hardness, Type A durometer points change	-	+5
Tensile strength, percent change	-	-15 max.
Water absorption, 48 hours percent	D570	0.5 max.
Specify gravity	D792	1.42 max

\* The hardness test shall be performed in accordance with D2240 except that the material is pressed to the durometer by thumb.

\*\* Resistance to alkali. A specimen, weighing about 2.65 oz, will be cut from the sample. The specimen will be washed in tap water, rinsed with distilled water, wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour. The weight of each specimen, to the nearest 0.00035 oz, will be recorded. The durometer reading will be taken as noted above. The specimens will be completely immersed in a freshly made solution containing 0.18 oz of chemically pure potassium hydroxide and 0.18 oz of chemically pure sodium hydroxide in one quart of distilled water, kept at 21E to 24EC. At the end of seven days the specimens will be removed, rinsed with distilled water, the surfaces wiped with a clean cloth, and allowed to dry in laboratory air for approximately 1 hour. The weight and durometer hardness will be measured and recorded. Tensile strength shall be determined as noted above. The weight and tensile strength change shall be reported as a percentage of the original readings. The hardness change will be reported as the change relative to the original reading.

**Cold Bend Test.** A cold bend test shall be made by subjecting a 1/2 inch by 6 inch by 1/8 inch strip of extrusion material to a temperature of -20°F for 2 hours. The strip shall immediately thereafter be bent 180 degrees around a rod of 1/4 inch diameter by applying sufficient force to hold the sample in intimate contact with the rod. The sample shall then be examined for evidence of cracking. There shall be no cracking of the samples.

**BASIS OF ACCEPTANCE.** Polyvinyl chloride extruded shapes and sheet material will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

### 705-12 PREFORMED ELASTIC TRANSVERSE CONTRACTION AND EXPANSION JOINT SEAL

**SCOPE.** This specification covers the material requirements for preformed elastic joint seal for use in transverse contraction joints and transverse expansion joints in concrete pavement.

**GENERAL.** The preformed elastic material shall be a vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The shape of any joint seal, from any manufacturer, shall be approved by the Director of the Materials Bureau prior to the submission of any individual production lot for approval. Such approval shall be requested in writing and be accompanied by a detailed drawing of the shape and a 15 foot length of the proposed seal. The lubricant used to install the



joint seal shall conform to 705-13, Lubricant for Preformed Elastic Joint Sealer, unless otherwise specified.

## MATERIALS REQUIREMENTS

**Geometric Requirements.** Joint seals shall meet the geometric requirements in the following table:

PROPERTY OR REQ. AT SPECIFIED WIDTH	TYPE OF SEAL			
	21/32 inch Transverse Contraction	25/32 inch Transverse Contraction	1 1/4 inch Transverse Contraction	1 5/8 inch Transverse Expansion
Overall width, min.	21/32 in.	25/32 in.	1 1/4 in.	1 5/8 in.
Contact Dimension, min.	21/32 in. @ 5/8 in. width	25/32 in. @ 5/8 in. width	7/8 in. @ 1 in. width	7/8 in. @ 1 1/4 in. width
Overall depth, max.	2 in. @ 1/2 in. width	2 in. @ 1/2 in. width	2 in. @ 5/8 in. width	2 in. @ 7/8 in. width

**Physical Requirements.** For all properties except compression-deflection, low-temperature recovery @ 14°F, and ozone resistance, the joint seal material shall be tested in accordance with AASHTO M220 and meet the physical requirements therein. The requirements for compression-deflection, low-temperature recovery @ 14°F and ozone resistance are waived.. Measurements for recovery may be made using an electronic caliper in addition to methods specified.

The following exceptions shall be made to the recovery test when the seal shape has a lip (a small protrusion at the top longitudinal edge). The seal shall be compressed to 50% of the nominal width of the seal. The denominator for the percent recovery calculation, however, shall be the width between the outer edges of the lips on the manufacturer's drawing. The numerator or recovered width shall be measured between the outer edges of the lips.

**Force-Deflection Requirements.** Force-Deflection properties shall be determined in accordance with the force-deflection test established by the Materials Bureau. A description of this test is available on request from the Materials Bureau.

The preformed elastic transverse joint seal shall conform to the following force-deflection requirements:

PROPERTY OR REQ. AT SPECIFIED WIDTH	TYPE OF SEAL			
	21/32 inch Transverse Contraction	25/32 inch Transverse Contraction	1 1/4 inch Transverse Contraction	1 5/8 inch Transverse Expansion
Min. Resisting Force (lb/in)	2.85 @ 5/8 in. width	2.85 @ 5/8 in. width	2.85 @ 1 in. width	2.85 @ 1 1/4 in. width
Max. Resisting Force (lb/in)	10.9 @ 1/2 in. width	9.14 @ 1/2 in. width	12.0 @ 5/8 in. width	20.0 @ 7/8 in. width

The seal shall not creep more than 1/4 inch horizontally during force-deflection testing, nor shall there be any loss of contact between the top edges of the seal and the compression plates.

All test sections used in the above procedures shall be cut and/or buffed from the joint seal specimens.

**BASIS OF ACCEPTANCE.** Preformed elastic transverse contraction expansion joint sealers will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **705-13 LUBRICANT FOR PREFORMED ELASTIC JOINT SEALER**

**SCOPE.** This specification covers the lubricant used for the installation of preformed elastic joint sealers.

**GENERAL.** The lubricant shall be a one-component polychloroprene compound containing only soluble phenolic resins blended together with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture.

**MATERIAL REQUIREMENTS.** The lubricant shall meet the following physical requirements: For use with concrete pavement sealers the lubricant shall conform to the requirements of ASTM D2835. For use with bridge sealers the lubricant shall conform to the requirements of ASTM D4070.

**PACKAGING.** Each lot of the lubricant shall be delivered in containers plainly marked with the manufacturer's name or trademark, lot number and date of manufacture.

**BASIS OF ACCEPTANCE.** The basis of acceptance for the lubricant shall be the manufacturer's certification as to compliance with this specification which shall accompany the material delivered to the job site. Any lubricant not used within 270 days of its manufacture shall be unacceptable.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

### **705-14 LONGITUDINAL JOINT TIES**

**SCOPE.** This specification details the requirements for longitudinal joint ties (LJTs) and their support assemblies used at longitudinal joints in portland cement concrete (PCC) pavement.

**GENERAL.** LJTs are either one-piece deformed bar reinforcement or multiple-piece systems consisting of deformed bar reinforcement with 1 or 2 threaded ends and a coupler. For longitudinal joints between lanes placed simultaneously, one-piece LJTs must be supported by an assembly that secures them in position when the assembly is affixed to the underlying pavement layer. For longitudinal joints between lanes placed separately, the LJTs are either:

- Loose, one-piece, deformed bars drilled and anchored into the vertical placement edge.
- Loose, multiple-piece systems.

In the latter case, the first piece is bolted to the paving forms in the initial concrete placement and the second piece threaded into the first piece after form removal from the initial placement. Refer to Section 502, PCC Pavement, to identify which method is used.

All LJTs not referenced on the Department's Approved List entitled "Longitudinal Joint Ties (705-14)," under "Joint Materials, Pavement," will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the Director, Materials Bureau, at least 120 days before their intended use. Approved LJTs and their support assemblies will be placed on

the Approved List and referenced by the drawing number and approval date. Any change to a previously approved LJT requires approval by the Director, Materials Bureau, before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the LJTs that arrive at Department contracts.

## **MATERIAL REQUIREMENTS**

**A. Deformed Bar Reinforcement.** Obtain deformed bar reinforcement from a manufacturer appearing on the Department's Approved List entitled "Reinforcing Bars (709-01)," under "Reinforcing, Steel." Use number 6 deformed bars made of Grade 60 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

Use one-piece LJTs having lengths as required by Section 502, PCC Pavement, and the associated 502 Standard Sheets for PCC Pavement, i.e.:

- 36 inches between travel lanes placed simultaneously (in support assemblies).
- 28 inches between travel lanes placed separately (drill and anchor method).
- 20 inches between a travel lane and PCC shoulder placed simultaneously (in support assemblies).
- 18 inches between a travel lane and PCC shoulder placed separately (drill and anchor method).

Use multiple-piece LJTs having lengths of 36 inches between travel lanes placed separately and 20 inches between a travel lane and a PCC shoulder placed separately. The length of a multiple-piece LJT includes only the deformed bar segment lengths, not the thread lengths nor the coupling length. When assembled, the coupler must cover all threads in the threaded ends.

**B. Coatings.** All LJT components must be epoxy-coated steel except for threaded connections. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, "Reinforcing, Epoxy and Coating:"

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with "Coating Application" in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under "Reinforcing, Epoxy and Coating:"

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Coatings must be continuous over the bar length, including couplers for multiple-piece ties, and 8 - 12 mils thick. Coatings must be within 1/4 inch of threaded ends in multiple-piece ties. The cross-sectional ends of the bars may be uncoated.

Damaged coatings may be repaired at the epoxy coating applicator's facility or at the fabricator's facility in accordance with "Repair of Coated Bars" in §709-04, Epoxy Coated Bar Reinforcement. Field repair of damaged coating is allowed, provided the damage is less than 1 inch long in any direction and more than 4 inches from the center of the bar or the threaded ends. Use a patching material supplied

by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete.

Follow the manufacturer's written recommendations regarding surface preparation and application. Provide those recommendations to the Engineer before field repairs are made. Apply the patching material to the damaged area only. Dipping the bar into the patching material, or liberally coating undamaged areas, is not allowed. Epoxy-coated bars with perforations, cracks, other damage, or improperly applied coatings will be rejected.

**C. LJT Support Assemblies.** Support one-piece LJTs in longitudinal joints between lanes placed simultaneously in assemblies or "baskets" that securely hold more than 1 LJT in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 or both ends of each LTD to the assembly by welding or mechanical fixation within 2 inches of the end of the LJT.

**D. Corrosion Inhibitors for Threaded Connections (Multiple-piece LJTs Only).** Use one of the following:

- Medium setting asphalt emulsion meeting Table 702-4 or Table 702-5.
- Thread-sealing compound approved by the Materials Bureau.

Apply the corrosion inhibitor to all threaded connections before the LJTs are assembled such that all surfaces of the assembled LJT are covered with an unbroken seal of epoxy coating or corrosion inhibitor. Do not apply corrosion inhibitors to bolts that hold multiple-piece LJTs to forms.

**GEOMETRIC REQUIREMENTS.** Unless otherwise indicated in the contract documents, fabricate the support assemblies or bolt multiple-piece LJTs to forms such that the:

- Assembly holds at least 2 LJTs.
- Entire longitudinal axis of each bar is located at the middepth of the pavement slab ( $\square$  1 inch).
- Longitudinal axes of the bars are aligned perpendicular to the pavement centerline and parallel with the pavement surface such that the maximum misalignment of 1 bar end relative to the other is 1 inch.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\square$  1 inch).
- Longitudinal axes of adjacent bars do not exceed the maximum spacing identified in the contract documents.
- Bars are 3 inches (minimum) away from other LJTs or transverse joint supports.

## TESTS

**A. Materials Details – LJT Support Assemblies.** The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:

- Manufacturer's name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Support assembly dimensions and tolerances.
- LJT positioning within the joint support assembly.
- LJT ASTM steel grade designation.
- A cross section showing the relative positioning of LJTs to their support legs.
- Method used to affix LJTs to the support assembly and the locations of points of fixation.
- Methods used to affix wires together in the support assembly and the locations of points of fixation.

- Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LJT support legs, stakes, and spacer wires, if any.
- A detail of wire legs that hold LJTs to the support assembly.
- A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
- The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction. The minimum number of stakes must equal the number of LJTs in the assembly.

**B. Materials Details – Multiple-Piece LJTs.** The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:

- Manufacturer’s name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Length of threaded ends.
- Thread size designations.
- LJT ASTM steel grade designation.
- Coupler dimensions and tolerances.
- Method used to affix LJTs to forms.

**C. Joint Support Assemblies.** Submit 2 complete LJT support assemblies and 6 loose, epoxy-coated LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

**D. One-Piece LJTs.** In addition to meeting Grade 60 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**E. Multiple-Piece LJTs.** Submit 12 multiple-piece LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification. When assembled, the multiple-piece ties shall have minimum yield strengths of 60 ksi. Also, multiple-piece LJTs must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**BASIS OF ACCEPTANCE.** Longitudinal Joint Ties will be accepted at the contract based on the Manufacturer’s appearance on the Department's Approved List entitled “Longitudinal Joint Ties (705-14),” under “Joint Materials, Pavement.” The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer’s certification that the LJTs were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the LJTs and the mill’s certification as to the type, grade, and ASTM designation of steel used in the LJTs.

- The brand name of the epoxy coating used on the LJT's and the name, address, telephone number, and e-mail address of the manufacturer.
- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator's certification that the coatings were applied in conformance to this specification.
- The brand name of the corrosion inhibitor for threaded coatings used on multiple-piece LJT's and the name, address, telephone number, and e-mail address of the manufacturer.

## 705-15 TRANSVERSE JOINT SUPPORTS

**SCOPE.** This specification details the requirements for load transfer devices (LTDs) and their support assemblies used at transverse joints in portland cement concrete (PCC) pavement.

**GENERAL.** All Transverse Joint Supports not referenced on the Department's Approved List entitled "Transverse Joint Supports (705-15)," under "Joint Materials, Pavement," will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the Director, Materials Bureau, at least 120 days before their intended use. Approved supports will be placed on the Approved List and referenced by the drawing number and approval date. Any change to a previously approved transverse joint support requires approval by the Director, Materials Bureau before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the joint supports assemblies that arrive at Department contracts.

## MATERIAL REQUIREMENTS

**A. Dowels.** Dowels are the LTD component of transverse contraction and expansion joint support assemblies. They are also used at transverse construction joints. Obtain dowels from a manufacturer appearing on the Department's Approved List entitled "Reinforcing Bars (709-01)," under "Reinforcing, Steel."

Use 18 inch long dowels made of plain, Grade 60 steel bar reinforcement having uniform circular cross sections for their entire lengths. Saw cut dowel ends such that they are free of burrs or projections. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Dowel diameters vary with pavement thickness as detailed in the Section 502 Standard Sheets. Coating thickness is not included in the dowel diameter.

**B. Deformed Bar Reinforcement.** Deformed bar reinforcement is the LTD component of transverse hinge joint support assemblies. Obtain bars from a manufacturer appearing on the Department's Approved List entitled "Reinforcing Bars (709-01)," under "Reinforcing, Steel." Use number 6 deformed bars, 24 inches long, made of Grade 60 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

**C. Coatings.** Steel LTDs (dowels and deformed bars) must be epoxy coated. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, "Reinforcing, Epoxy and Coating:"

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with “Coating Application” in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under “Reinforcing, Epoxy and Coating:”

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).
- Epoxy Coatings for Dowel Bars for Transverse Joint Supports (705-15).

Coatings must be continuous over the length of the LTD and 10 - 18 mils thick, except for the cross-sectional ends, which may be uncoated. Field repair of damaged coatings is not allowed. Plant or facility repairs are not allowed unless the damage results from welding or mechanical fixation to the support assembly and is within 1 inch of the weld or fixation point. Such damage must be repaired before visible rust occurs. Use a patching material supplied by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete. Apply the patching material to the damaged area only. Dipping the LTD into the patching material, or liberally coating undamaged areas, is not allowed. Supports containing LTDs with perforated, cracked, otherwise damaged, or improperly applied coatings will be rejected.

Completely coat each dowel with a bond breaker applied at the epoxy coating applicator facility or the joint support assembly facility. The bond breaker is subject to approval by the Materials Bureau. Do not apply a bond breaker to deformed bar reinforcement.

**D. Premolded Resilient Joint Filler (§705-07).** Use 3/8 - 5/8 inch thick filler in transverse expansion joint assemblies only.

**E. Joint Support Assemblies.** Support LTDs in assemblies or “baskets” that securely hold them in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 end of each LTD to the assembly by welding or mechanical fixation. Affix alternating ends of adjacent LTDs to the assembly such that the point of fixation is within 2 inches of the end of the LTD.

## GEOMETRIC REQUIREMENTS

**A. Transverse Contraction Joints.** Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

- Entire longitudinal axis of each dowel is located at the middepth of the pavement ( $\pm \square 1/4$  inch).
- Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is 1/8 inch.
- Midpoint of the longitudinal axis of each dowel is at the center of the joint ( $\square \pm 1$  inch).
- Longitudinal axes of the two end dowels are 4 - 8 inches from the longitudinal joints.
- Longitudinal axes of the dowels are spaced 4 - 12 inches apart.

**B. Transverse Expansion Joints.** Fabricate the support assemblies such that the dowels are positioned in accordance with paragraph A, Transverse Contraction Joints. Include a one-piece premolded resilient joint filler in the assembly that extends completely across the slab width. The joint filler must either equal the full depth of the slab, or extend from the bottom of the slab to within 1 1/2 - 2 inches of the top of the slab with a finishing cap that extends to the top of the slab.

Vertically support the filler at the longitudinal midpoints of the dowels and perpendicular to the longitudinal axes of the dowels. Depict support mechanisms in the Materials Details. Do not weld the dowels to filler supports.

Place plastic expansion caps on the free ends of the dowels (the ends opposite the fixed ends). Use expansion caps with essentially the same inner diameter as the outer diameter of the dowel plus coating thickness (+ 40 mils).

**C. *Transverse Hinge Joints.*** Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

- Entire longitudinal axis of each deformed bar is located at the middepth of the pavement slab ( $\pm 1$  inch).
- Longitudinal axes of the deformed bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 1 inch.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\pm 1$  inch).
- Longitudinal axes of the two end bars are 4 - 12 inches from the longitudinal joints.
- Longitudinal axes of the bars are spaced 4 - 18 inches apart.

## TESTS

**A. *Materials Details.*** The transverse joint support manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. Depict only one type of joint on each detail submitted for approval. The Materials Details must depict the following minimum information:

- Manufacturer's name, address, telephone number, fax number, and e-mail address.
- Type of support (contraction, expansion, or hinge joint).
- Drawing number.
- Joint support assembly dimensions and tolerances.
- LTD length, spacing, and positioning within the joint support assembly.
- LTD ASTM steel grade designation.
- Bond breaker brand name and manufacturer.
- A cross section showing the relative positioning of LTDs to their support legs.
- Method used to affix LTDs to the support assembly and the locations of points of fixation.
- Methods used to affix wires together in the joint support assembly and the locations of points of fixation.
- Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LTD support legs, premolded resilient joint filler supports (expansion joints only), stakes, and spacer wires that hold cages in place during transport.
- A detail of wire legs that hold LTDs to the support assembly.
- A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
- The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction.
- Methods used to support premolded resilient joint fillers (expansion joints only).
- Expansion cap material and dimensions (expansion joints only).



**B. Joint Support Assemblies.** Submit 2 complete joint support assemblies and 6 loose, epoxy-coated LTDs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

**C. Epoxy-Coated Dowels.** In addition to meeting the Grade 60 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated dowels must meet the Load-Deflection, Pull-out, Abrasion, Corrosion, Chemical Resistance, Cathodic Disbonding, Coating Hardness, and Coating Impact Resistance requirements of AASHTO M254, Corrosion-Resistant Coated Dowel Bars, when tested in accordance with AASHTO T253, Coated Dowel Bars.

**D. Epoxy-Coated Deformed Bar Reinforcement.** In addition to meeting Grade 60 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**E. Field Test.** Only joint support assemblies meeting the above test requirements will be considered for trial installation in a field test. The supplier or manufacturer is responsible for coordinating the field test. The field test location may be:

- Part of a Department contract.
- Part of a contract under the jurisdiction of an agency other than the Department.
- A test site arranged by the supplier or manufacturer.

If the field test is outside New York State, the location must meet the approval of the Director, Materials Bureau.

If the field test is part of a Department contract, the Contractor must obtain the Engineer's approval before any support assemblies are installed. If the field test is at a test site arranged by the supplier/manufacturer, install the joint support assemblies in a 150 foot long (minimum) pavement constructed in accordance with Section 502, Portland Cement Concrete Pavement. In any case, a minimum of 10 joints must be constructed using the joint supports.

Conduct field tests in the presence of Materials Bureau personnel. Specific attention will be given to handling, coating integrity, damage, alignment before and after paving, fixation failure, securing to underlying layers, contraction joint formation, and general specification conformance. Failing assemblies, and the pavement they are constructed into if part of a Department contract, will be rejected and removed and replaced at no cost to the State.

The Director, Materials Bureau, may waive field tests for hinge and expansion joint assemblies or from manufacturers who have an established history of successful contraction joint assembly installations with the Department.

**BASIS OF ACCEPTANCE.** Transverse joint supports will be accepted at the contract based on the Manufacturer's appearance on the Department's Approved List entitled "Transverse Joint Supports (705-15)," under "Joint Materials, Pavement." The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer's certification that the joint supports were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the

LTDs and the mill's certification as to the type, grade, and ASTM designation of steel used in the LTD.

- The brand name of the epoxy coating used on the LTDs and the name, address, telephone number, and e-mail address of the manufacturer.
- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator's certification that the coatings were applied in conformance to this specification.
- The brand name of the bond breaker used on the dowels and the name, address, telephone number, and e-mail address of the manufacturer.

#### **705-16 CONCRETE PIPE JOINT SEALING COMPOUND**

**SCOPE.** This specification covers a flexible/rubber sealer used for joints in elliptical pipe, cattle pass and drainage units.

**MATERIAL REQUIREMENTS.** Concrete pipe joint sealing compound shall conform to the requirements of ASTM C990.

**BASIS OF ACCEPTANCE.** Label stating conformance to ASTM C990. Labels shall be either attached directly to the sealing compound or to the packaging in which the compound arrives at the project site.

#### **705-17 CONCRETE PIPE JOINT ELASTOMERIC GASKETS**

**SCOPE.** This specification covers elastomeric gaskets used for joints in round pipe.

**MATERIAL REQUIREMENTS.** Concrete pipe joint elastomeric gaskets shall conform to the requirements of either ASTM C443 or ASTM C361.

**BASIS OF ACCEPTANCE.** Label stating conformance to either ASTM C443 or ASTM C361. Label shall be either stenciled on the elastomeric gaskets, attached directly to the gaskets or attached to the packaging in which the gaskets arrive at the project site.

#### **705-18 ASPHALTIC PLUG JOINTS FOR BRIDGES**

**SCOPE.** This specification covers the material requirements for asphaltic plug bridge joint systems.

**MATERIAL REQUIREMENTS.** The materials used to construct the asphaltic plug bridge joint system must conform to the requirements of ASTM D6297 with the following exception:

- No aluminum plate will be allowed at this time.
- No sampling required.

Each manufacturer shall provide Materials Detail Sheets as part of the acceptance procedure to the Department. The installers/contractors shall adhere to approved manufacturer's Materials Details for preparation, construction, and curing.

The Materials Details shall provide the following:

##### **1. Product Information:**

- Identify Components
- Packing, storage and handling requirements

**2. Surface Preparation:**

- Weather limitations and surface conditions
- Preconditioning (removal) of existing joint system
- Surface preparation and level of cleanliness
- Address any structural repairs needed and method of repair to include compatible materials needed.

**3. Application Procedures:**

- Describe all procedures to be followed in preparation, heating, mixing and installation of system.

**4. Curing:**

- Describe curing procedure and anticipated cure times vs. temperature (Table recommended)
- Describe test(s) performed for quality assurance

**PACKAGING.** All components shall be shipped in appropriate containers, bearing the manufacturer's label specifying date of manufacture, batch number, brand name, quantity, and date of expiration or shelf life.

**BASIS OF APPROVAL.** Each system supplier/manufacturer must prove to the Department through acceptable field performance of this item prior to approval and acceptance to the Department's Approved List.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name and system appearing on the Department's Approved List which will be accompanied by the Department's approved Materials Detail Sheet (MDS).

**705-19 ASPHALT PAVEMENT JOINT ADHESIVE**

**SCOPE:** The joint adhesive materials must be on the Department's Approved list. This standard specification covers the material requirements and the approval process of joint adhesive material applied during the construction of HMA joints.

**GENERAL:** The Joint Adhesive is a hot-applied modified asphalt product used to adhere and seal all pavement joints during the placement of HMA. It is supplied as a ready to use solid which is removed from the container, heated to application temperature and then applied to the face of construction joints prior to placing the adjacent mat.

**MATERIAL REQUIREMENTS.**

The Joint Adhesive shall conform to the requirements of the following tests:

Test	Specification Limits
Cone Penetration, 77°F (25°C) (ASTM D 5329)	60-100
Flow, 140°F (60°C) (ASTM D 5329)	1/5 inch maximum
Resilience, 77°F (25°C) (ASTM D 5329)	30% minimum
Ductility, 77°F (25°C) (ASTM D 113)	1 foot minimum
Tensile Adhesion, 1 in. thick Specimen, 24 hour dry blocks (ASTM D 5329)	500% minimum
Flexibility, 0°F (-18°C) (ASTM D3111 modified)	Pass
Softening Point (ASTM D 36)	170°F minimum
Asphalt Compatibility (ASTM D 5329)	Pass

**BASIS OF ACCEPTANCE.** All components shall be shipped in appropriate containers, bearing the manufacturer's label specifying date of manufacture, batch number, brand name, quantity, MSDS and date of expiration or shelf life.

**BASIS OF APPROVAL.** Suppliers must submit the test results, manufacturer's literature, and samples of the joint adhesive materials to the Director, Materials Bureau prior to installation. The Department will test provided samples of the joint adhesive. If the results are satisfactory, the joint adhesive will be placed on the Department's Approved list with hyperlink to manufacturer's literature.

**705-20 FOR SITE MANAGER USE**

**705-21 MASONRY MORTAR**

**SCOPE.** Requirements for the 3 common types of masonry mortar (N, S and M - increasing in strength, respectively). Use these mortars to bind masonry units together to construct masonry structures, repair masonry structures (tuck pointing), or bed and bond masonry or concrete units together. For historic masonry structures made with soft hydrated lime mortars, use a specially designed lime mortar as shown in the Contract Documents or as approved by the Engineer.

- Type N Masonry Mortar- for tuck pointing repair of structures made with fired clay bricks
- Type S Masonry Mortar- for new structures made with all types of masonry, including brick
- Type S Masonry Mortar- for tuck pointing repair of structures made with masonry other than clay brick
- Type M Masonry Mortar- for new and tuck pointing repair of rigid masonry riding surfaces, such as bridge decks, pavements, sidewalks, and other roadway areas subject to severe weathering and abrasion conditions

**MATERIAL REQUIREMENTS**

Portland Cement, Type II or VI	701-01
Masonry or Mortar Cement, Type N, S or M	701-02
Blended Portland Cement	701-03
Mortar Sand	703-03
Concrete Sand	703-07
Water	712-01

Proportion the N, S or M mortar type by loose volume parts as follows:

PORTLAND OR BLENDED PORTLAND CEMENT	MASONRY OR MORTAR CEMENT	SAND
<b>Type N Mortar (make with Type N Masonry or Mortar Cement)</b>		
0	1 (Type N)	2 1/4 to 3
<b>Type S Mortar (make with Type S or N Masonry or Mortar Cement)</b>		
0	1 (Type S)	2 1/4 to 3
1/2	1 (Type N)	3 3/8 to 4 1/2
<b>Type M Mortar (make with Type M or N Masonry or Mortar Cement)</b>		
0	1 (Type M)	2 1/4 to 3
1	1 (Type N)	4 1/2 to 6

After adding all ingredients (including water) to a mechanical mixer, mix for 3 to 5 minutes to entrain air and produce a workable and uniform consistency. Discard all unused mortar 2 1/2 hours after initial

mixing. Mortar that has stiffened may be re-tempered up to 2 1/2 hours after initial mixing by adding water to restore the original workable consistency.

Use a uniform layer of mortar, 1/4 to 3/4 inch thick, for joints between uniform masonry units. For a tuck pointing (raking out and repointing) mortar, add the minimum water to the dry ingredients to produce a mortar that retains its form when hand squeezed and released. Allow this mortar to stand covered (prehydrate) for 1 to 1 1/2 hours to greatly reduce shrinkage. Then mix with sufficient water to produce a stiff, but workable consistency, and use within 2 1/2 hours of initial mixing.

Avoid re-tempering the mortar when tuck pointing, matching a color, or to avoid color variations between batches (mix smaller quantities, if needed).

No admixtures, except for mortar coloring agents made from light-fast, durable, alkali-resistant minerals, will be permitted without written permission of the Director, Materials Bureau. If colored mortar is specified, submit samples of hardened mortar to the Engineer. Upon approval, use the same, uniform, mortar color throughout the work.

**BASIS OF ACCEPTANCE.** Inspection and approval by the Engineer.

### **705-22 PORTLAND CEMENT MORTAR BONDING GROUT**

**SCOPE.** This specification covers the material requirements for portland cement mortar grout used for bonding fresh concrete to hardened concrete in both vertical and horizontal planes.

**MATERIAL REQUIREMENTS.** The ingredients for the portland cement mortar grout shall comply with the following:

Portland Cement, Type 1 or Type 2	701-01
Mortar Sand	703-03
Concrete Sand	703-07
Water	712-01

**Proportioning.** The mortar grout shall have the cement and mortar or concrete sand proportioned 1:1 in separate volumetric containers. The sand shall be deposited into an approved mechanical grout mixer prior to the cement. Both the sand and cement shall be dry mixed for one (1) minute. After dry mixing, water shall be added in sufficient quantity to result in a workable consistency. An additional three (3) minutes of mixing is required after adding desired water. Workable consistency is defined as a grout that will not run on vertical faces or puddle in low spots. Any grout that has dried or become unworkable, as determined by the Engineer, shall not be incorporated in the work. Hand mixing of the mortar may be permitted only for small quantities as approved by the Engineer.

**BASIS OF ACCEPTANCE.** The mortar grout shall be accepted on the basis of inspection and approval by the Engineer.

### **705-23 FOAM-SUPPORTED SILICONE**

**SCOPE.** This specification covers the requirements for foam-supported silicone.

It is sized to expand to the design requirements and stay in place under continuous compressive forces in the bridge joint opening during all movements anticipated by the bridge joint. The materials shall be supplied in a pre-compressed state to fit into the joint.

**MATERIALS.** The material shall be high density expanded foam attached to highway grade factory-installed silicone.

## PHYSICAL CHARACTERISTICS

### Foam Seal

Density	4-6 lb/cu. ft.
Temp. Stability Range	-40°F to 185°
Staining/Bleeding	None at 212° F at 20%
Tensile Strength	ASTM 3574, 21 psi min.
Elongation	ASTM 3574, 125% ±20%
Resistance to Compression Set	ASTM 3574 Max 3%
Mildew Resistance	Excellent
UV Resistance	Excellent

### Silicone

Durometer Hardness,	Shore A 15-25
Elongation	Min 1200%
Tensile Strength	>120 psi

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the product name appearing on the Department's Approved List for Foam-Supported Silicone. The procedural directives to apply for Approved List status are available from the Materials Bureau.

## 705-99 FOR SITE MANAGER USE

### SECTION 706 - CONCRETE, CLAY AND THERMOPLASTIC PIPE

(Last Revised January, 2019)

#### 706-01 NON-REINFORCED CONCRETE PIPE

**SCOPE.** This specification covers the material and quality requirements for non-reinforced concrete pipe 24 inches and smaller used for culverts.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe, shall apply except that all references to reinforcing steel shall be deleted. In addition, physical and dimensional requirements of concrete pipe under 12 inches in diameter shall be as stated in Table 1, Class 1, of ASTM C14. Plain concrete pipe 12 to 24 inches in diameter shall conform to Table 1, Class 2, of ASTM C14.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that all references to reinforcing steel shall be deleted.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Marking.** No pipe class or wall designation shall be marked on the pipe.

**PHYSICAL REQUIREMENTS.** The Physical Requirements contained in §706-02 shall apply except as noted herein.

**Strength.** The strength requirements for the respective diameter pipe sizes shall be as stated in Table 1 of ASTM C14. Details of the three-edge bearing test shall comply with ASTM C14.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §706-02 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §706-02 shall apply.

**SHIPPING.** The Shipping requirements contained in §706-02 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §706-02 shall apply.

## **706-02 REINFORCED CONCRETE PIPE CLASSES II, III, IV, V**

**SCOPE.** This specification covers the material, fabrication, and physical requirements of reinforced concrete pipe and cattle pass.

**GENERAL.** Apply the requirements of AASHTO M 170, Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Classes II, III, IV, and V, except as modified by this specification. Produce reinforced concrete pipe by either machine made or wet cast methods in accordance with working drawings approved by the Department and in full compliance with the details of this specification. Pipe manufactured for a specific class will be acceptable for any class having a lower design strength.

Methods of manufacture include the following:

**A. *Wet Cast Pipe And Cattle Pass.*** Wet cast units are those made from concrete placed and consolidated by conventional equipment. These units develop resistance to freeze-thaw damage through the use of entrained air in the concrete. Air content in wet cast concrete shall range between 5.0% and 9.0%.

Manufacture wet cast pipe, for Department acceptance, in accordance with this specification and the current Materials Procedure for precast concrete titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**B. *Machine Made Pipe.*** Machine made units use very low slump concrete and methods of consolidation which produce a dense product with low permeability and good resistance to freeze-thaw damage.

Manufacture machine made pipe, for Department acceptance, in accordance with this specification and the current Materials Method titled “Quality Assurance Procedure For Concrete Pipe Items”.

## **MATERIAL REQUIREMENTS**

### **A. *Materials***

Portland Cement (Type 1, Type 2 or Type 3)	701-01
Concrete Repair Material	701-04
Concrete Repair Material - High Early Strength	701-12
Coarse Aggregate	703-02
Concrete Sand	703-07
Bar Reinforcement, Grade 60 (Reinforcement & Stirrups)	709-01
Wire Fabric for Concrete Reinforcement	709-02
Bar Reinforcement, Grade 40	709-03
Cold Drawn Wire for Concrete Reinforcement	709-09
Admixtures	711-08
Water	712-01
Concrete Pipe Joint Sealing Compound	705-16

Concrete Pipe Joint Elastomeric Gaskets	705-17
Fly Ash	711-10
Ground Granulated Blast Furnace Slag	711-12

**B. Cementitious Content.** Use a minimum combined cementitious content of 565 lb/cy. This includes the Portland Cement and pozzolan (fly ash and/or ground granulated blast furnace slag). The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cementitious material tested in accordance with written procedural directives of the Materials Bureau.

**C. Pozzolans.** Fly ash and/or ground granulated blast furnace slag may, in total, be substituted for cement up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix.

**D. Admixtures.** Calcium Chloride is not allowed in concrete. Admixtures, other than an approved Air Entraining agent for wet cast pipe, are not allowed unless otherwise approved by the Materials Bureau.

**E. Reinforcement.** Sample the reinforcement in accordance with the written directives of the Materials Bureau. Accept stirrups based on the manufacturer's certification, unless otherwise directed by the Materials Bureau.

**F. Pipe Joint Materials**

**1. Elastomeric Gaskets.** The gaskets used in the installation of round pipe shall meet the specification requirements of §705-17 and only those types and sizes designated by the pipe manufacturer on the approved drawings of the particular pipe.

**2. Sealing Compounds.** Concrete pipe joint sealing compound, meeting the specification requirements of §705-16, shall be used only on elliptical pipe and reinforced cattle pass.

**FABRICATION REQUIREMENTS**

**Drawings.** Submit detailed working drawings conforming to the Materials Bureau concrete pipe templates. All diameter sizes of a particular geometric shape can be included on one drawing. Separate drawings are required for cattle pass, jacking pipe and special designs.

Full approval of the working drawings is required prior to the manufacture of any concrete pipe.

**Design, Reinforcement and Dimensions**

**A. General.** Apply the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170 for Class II, III, IV and V pipe, walls B & C. The AASHTO tables show minimum reinforcement. The manufacturer may submit drawings detailing alternatives to the specified reinforcement and/or wall thickness for Materials Bureau consideration. To gain full approval of alternate designs, manufacture and test pipe samples in accordance with the written procedural directives of the Materials Bureau.

**B. Reinforced Concrete Cattle Pass.** Apply the requirements of applicable Standard Sheet with the following modification. A minimum length of 48 inches is required for each section. The maximum allowable variation in laying lengths of two opposite sides of a cattle pass section is 1/8 inch per 12 inches of diameter, not to exceed 5/8 inch in any length of cattle pass, except where beveled or curved cattle pass lengths have been specified.



## Concrete Batch Placement

**A. Machine Made Pipe.** Clean and properly assemble the forms prior to placing any concrete. Transport and place the concrete mixture such that no segregation of the concrete materials or displacement of the reinforcing steel occurs within the form.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Concrete Placement And Consolidation requirements contained in §704-03.

**Curing.** Include the type of curing, curing time and any temperature requirements on the drawing.

**A. Machine Made Pipe.** Cure the pipe in accordance with AASHTO M 170. Other methods of curing are subject to approval by the Director, Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Curing requirements contained in §704-03.

**Joints.** Use either bell and spigot or tongue and groove design. Design the joints so as to permit effective jointing to reduce leakage and infiltration and to permit placement without irregularities.

**Marking.** The pipe markings must be identified on the inside barrel for pipe diameters of 1 1/2 feet and greater. If the diameter is less than 1 1/2 feet the markings may be stenciled on the outside of the pipe. Mark each piece of pipe with the following information, as applicable.

- 1.Name or trademark of manufacturer.
- 2.Date of manufacture.
- 3.Pipe class.
- 4.Wall designation.
- 5.Pipe diameter.
- 6.NYSDOT lot number (“NYSDOT            ”) (Machine made pipe only.)
- 7.Indelibly mark the word “TOP” on the inside and outside of the barrel at the appropriate location on each pipe length with elliptical or quadrant reinforcing.

## Repair

**A. Machine Made Pipe.** Pipe may be repaired at the plant or in the field using 701-04 Concrete Repair Material or §701-12 Concrete Repair Material - High Early Strength. Repairs to more than 10% of a lot will not be permitted. Repairs will be acceptable if, in the opinion of the Department, the repairs are sound, properly finished and cured, and the repaired pipe conforms to the requirements of these Specifications and the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Repair requirements contained in §704-03.

## PHYSICAL REQUIREMENTS

**Strength.** Apply the requirements of AASHTO M 170 except that the compressive strength requirements do not apply except for cattle pass. Conduct such number and type of three edge bearing tests as the Materials Bureau deems necessary to establish the quality of pipe.

Reinforced concrete cattle pass will not require a three-edge bearing test. The minimum 28 day compressive strength for cattle pass, as determined by concrete cylinders, is 3000 psi.

**Absorption Requirements For Machine Made Pipe.** The maximum average absorption for all pipe is 8.0% by weight for the last three specimens tested.

**Freeze-Thaw Requirements.** The Materials Bureau reserves the right to test the pipe for durability by freeze-thaw testing. The test will be run in accordance with written procedural directives of the Materials Bureau.

**SAMPLING AND TESTING.** It is required that each manufacturer have a testing machine, of a type approved by the Materials Bureau, to carry out three edge bearing tests. Employ a commercial testing agency to calibrate the testing machine according to ASTM E4 at a minimum of once a year. Upon request of the Materials Bureau, furnish a record of this calibration. Sample and test reinforced concrete pipe and cattle pass units, manufactured under the requirements of this specification, as follows.

**A. Machine Made Pipe.** Separate machine made reinforced concrete pipe into specific and identifiable production lots. Follow the written procedural directives of the Materials Bureau to determine the maximum number and type of units in a lot and the number of samples to be taken per lot. Test each lot of machine made reinforced concrete pipe as follows:

**1. Three Edge Bearing Test.** Follow the requirements for strength testing indicated above using the test procedure identified in the procedural directives issued by the Materials Bureau. Perform tests in the presence of a representative of the Department.

**2. Absorption Test.** Cores from each lot, drilled by the manufacturer in the presence of a representative of the Department, will be used for this test. The cores will be tested by the Materials Bureau in accordance with the test method specified in ASTM C497 except that under “absorption test” the drying period will be 48 hours at a temperature of 230°F.

Plug the holes when cores are taken. Ensure that plugs are sound, properly finished and cured according to the requirements of “Pipe Repair.”

In addition to the above tests, pipe will be subject to inspection at any time prior to placing, and rejection may be made through failure to comply with the criteria shown in the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Sample and test wet cast reinforced concrete pipe and cattle pass in accordance with Materials Bureau requirements contained in the current Materials Procedure for precast concrete, titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**FINAL PRODUCTION INSPECTION.** For wet cast units only, follow the Final Production Inspection requirements contained in §704-03.

## SHIPPING

**A. Machine Made Pipe.** No units will be considered for shipment unless the units are free from defects as noted under Pipe Repair in this specification and according to the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Shipping requirements contained in §704-03.

## BASIS OF ACCEPTANCE

**A. Machine Made Pipe.** Units will be accepted in stock lot quantities at the manufacturing location in accordance with the current version of Materials Method 1 titled “Quality Assurance Procedure For Concrete Pipe Items”.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Basis Of Acceptance requirements contained in §704-03.

## **706-03 REINFORCED CONCRETE ELLIPTICAL PIPE; CLASSES HE-II, HE-III, HE-IV, VE-IV, VE-V AND VE-VI**

**SCOPE.** This specification covers the material and quality requirements for both horizontal and vertical elliptical reinforced concrete pipe of the classes noted above for use as culvert pipe. Pipe designed for placement with the major axis horizontal is designated as horizontal elliptical pipe. Pipe designed for placement with the major axis vertical is designated as vertical elliptical pipe.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe Classes II, III, IV, V shall apply except as noted herein.

All references to AASHTO M 170, contained in §706-02, shall be replaced with AASHTO M 207. All reference to Classes II, III, IV and V, contained in §706-02, shall be deemed to include all classes of elliptical pipe.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that the pipe joint material shall be a sealing compound meeting the requirements of §705-16.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Design, Reinforcement and Dimensions.** In the case of elliptical pipe, the working drawings indicate the equivalent round pipe diameter, rise, span and class. A tolerance of plus or minus 2% from the nominal rise and span of the pipe, as shown on the approved working drawing, will be permitted.

Variations in laying lengths of two opposite sides of a pipe section shall not be more than 1/8 inch per foot of equivalent diameter, with a maximum of 5/8 inch in any length of pipe, except where beveled or curved lengths have been specified.

**Marking.** No wall designation shall be marked on the pipe. An equivalent round pipe diameter shall be used for markings.

**PHYSICAL REQUIREMENTS.** The Physical Requirements contained in §706-02 shall apply.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §706-02 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §706-02 shall apply.

**SHIPPING.** The Shipping requirements contained in §706-02 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §706-02 shall apply.

## **706-04 PRECAST CONCRETE DRAINAGE UNITS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete drainage units including transverse drainage interceptors.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein.

The concrete used to fabricate round precast concrete drainage units shall have a minimum compressive strength of 4000 psi @ 28 days. The concrete used to produce machine made units shall have a maximum absorption of 8.0% by weight and is not required to be air entrained.

Additional materials listed below shall meet the requirements of the following subsections:

Frames And Grates	655
Concrete Grouting Material	701-05
Concrete Pipe Joint Sealing Compound	705-16
Concrete Pipe Joint Elastomeric Gaskets	705-17
Mortar For Concrete Masonry	705-21
Steps For Manholes	725-02

**DRAWINGS.** The Drawing requirements contained in §704-03 along with the following shall apply.

Fabricator Working Drawings are required for all round drainage structures. Cut sheets, showing structure heights, the size and location of pipe openings and step locations are required for all drainage structures.

**FABRICATION.** The Fabrication requirements contained in 704-03, along with the following shall apply.

**Manufacturing Process.** Precast concrete drainage units shall be wet cast or machine made.

**A. Wet Cast.** Wet cast units are manufactured from concrete, placed and consolidated by conventional equipment, containing entrained air to develop resistance to freeze-thaw damage.

**B. Machine Made.** Machine made units are manufactured with very low slump concrete, consolidated to produce a dense product with low permeability and good resistance to freeze-thaw damage. Machine made units are those made by the following methods:

- Packerhead
- Roller suspension
- Centrifugal
- Machine tamped
- Machine vibrated
- Other methods as approved by the Materials Bureau

**Reinforcing.** Reinforcing bar splices shall be lapped a minimum of 30 bar diameters and tied securely. Wire fabric splices shall be secured by one of the following methods:

**A. Tying.** Under this method the ends shall lap to a length of not less than 30 diameters of the reinforcement and the lap shall contain a longitudinal member. A sufficient number of laps shall be tied to maintain continuity of the cage through the period of placement and curing of the concrete.

**B. Welding.** Each circular member shall be lapped a minimum of 2 inches and welded. The weld shall develop a minimum of 50 percent of the specified strength of the wire.

**Round Units.** Precast bases, floors, risers, conical top sections, grade rings and flat slab tops shall conform to the design, dimension and reinforcement requirements of ASTM C478. The C478 requirements for splices, laps and welds shall not apply.

**Transverse Drainage Interceptors.** Bar reinforcement shall be epoxy coated meeting the requirements of §709-04.

**Joints.** Joints between precast riser sections shall be formed with male and female ends so that when the sections are assembled they will make a continuous and uniform unit.

**Joint Sealant Materials.** Joints between precast sections are to be sealed with flexible watertight Elastomeric Gaskets, Pipe Joint Sealing Compounds, Mortar for Concrete Masonry, Concrete Grouting Material or Concrete Repair Material meeting the requirements of the Standard Specifications. If elastomeric Gasket Sealers are used the shape, size and placement shall be recommended by the precast manufacturer.

**Steps for Drainage Units.** Steps for drainage units shall conform to §725-02, Steps for Manholes. Steps in risers and conical top sections shall be aligned to form a continuous ladder with rungs equally spaced vertically in the completed unit at a maximum spacing of 16 inches. All steps in a completed drainage unit shall be the same size. Steps shall be embedded into the walls of the section a minimum of 3 inches. The rung shall project a minimum clear distance of 4 inches from the walls of the section measured from the point of embedment. If the steps are grouted, the grouting material shall conform to §701-04 Concrete Repair Materials or §701-05 Concrete Grouting Material, or §701-12 Concrete Repair Material - High Early Strength. If plastic inserts are used for installing steps, they shall be approved by the Materials Bureau. Steps which are damaged during installation or handling shall be replaced.

**Frames for Grates.** Frames cast into the top slab or top of the uppermost riser shall be secured and held in place by a minimum of 4 stirrups or studs per frame, welded to the frame near the corners. Parallel bar frames shall contain shear stud anchors, for the purpose of transferring loads, as required and detailed on the standard sheet for parallel bar grates and frames. Shear stud anchors, when required, shall replace the frame securing stirrups or studs.

#### **Dimensional Tolerances.**

##### **A. Drainage Units (Rectangular / Square).**

- Internal dimensions +5/8 inch, -1/2 inch
- Wall thickness
  - 6 inches +3/4 inch, -1/4 inch
  - ≥8 inches +3/4 inch, -1/2 inch
- Reinforcing steel cover
  - Walls (inside face) 2 inches (min), 4 inches (max)
  - Base (inside face) 2 inches (min), 3 1/4 inches (max)
  - Roof (all faces) +5/8 inch, -1/4 inch
  - Pipe openings (2 inches) ±1 inch
- Step spacing and alignment ±3/4 inch

##### **B. Drainage Units (Round).**

- Internal diameter
  - ≤60 inches ±5/8 inch,
  - >60 inches & ≤ 96 inches ±3/4 inch
  - >96 inches ±1 1/2 inches

- Wall thickness
 

Internal diameter $\leq$ 60 inches	+5/8 inch, -1/4 inch
Internal diameter >60 inches & $\leq$ 96 inches	+3/4 inch, -1/2 inch
Internal diameter >96 inches	+1 inch, -5/8 inch,
Reinforcing steel cover	
Base, Roof and Walls	+5/8 inch, -1/4 inch
Pipe openings (2 inches)	$\pm$ 1 inch
- Step spacing and alignment  $\pm$ 3/4 inch

**SAMPLING AND TESTING.** The sampling and testing requirements contained in 704-03 shall apply except as noted herein.

**A. Machine Made Units.** Testing for air content is not required. Cores shall be taken from the hardened concrete and tested for absorption. A minimum of 3 cores per 5 batches of a single mix with a minimum of three cores per day per mix shall be used to measure absorption. The average absorption of the 3 cores shall not exceed the maximum absorption specified herein. Testing shall be in accordance with ASTM C497 except that the drying period shall be 48 hours at a temperature of 230°F.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the inside face of all precast pieces. Each flat slab top that doesn't have an integral frame or a design that readily indicates the top surface shall have the words "INSTALL THIS SIDE UP" placed on its top surface.

The markings on rectangular drainage units, including base slabs, bases and risers, shall include the maximum placement depth in feet ("MPD...feet"). The maximum placement depth is based on wall thickness and reinforcement and shall be in accordance with the Department's Standard Sheets or the contract plans.

Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in 704-03 shall apply.

### **706-05 POROUS CONCRETE PIPE UNDERDRAIN**

**SCOPE.** This specification covers the material and quality requirements for porous concrete pipe and extra strength concrete porous concrete pipe underdrains.

**GENERAL.** Porous concrete pipe and extra strength porous concrete pipe shall be manufactured in accordance with approved working drawings and in compliance with details set forth below.

**MATERIAL REQUIREMENTS.** All materials shall comply with the requirements of ' 706-02, Reinforced Concrete Pipe, except that reinforcement shall not be used.

**Drawings.** Drawings shall be furnished in accordance with the provisions of ' 706-02.

**FABRICATION.** Porous concrete pipe and extra strength porous concrete pipe shall conform in size and shape to the details shown on the standard sheet for porous concrete pipe underdrain and the approved working drawing.

The inside surface of the pipe shall be straight and true to dimensions with a permissible variation from the true form of not more than 1 1/2 percent. A tolerance of 5% will be permitted in the diameter of the pipe. The wall thickness of the pipe may be greater than shown on the standard sheet, but it shall not be less than 95% of the stipulated wall thickness.

High early strength cement, calcium chloride or any other additive shall not be used unless otherwise approved by the Materials Bureau.

Concrete mix proportions will be such that will produce a concrete mix of such quality that the pipe will conform to the test and design requirements of these specifications.

Each length of pipe shall be clearly marked on the outside with the name or trademark of the manufacturer. Extra strength porous concrete pipe underdrain shall be clearly marked, "Extra Strength".

**Curing.** All pipe shall be cured in accordance with the provisions of 706-02.

**Strength Requirements.** The minimum ultimate strength for the size of the pipe being tested shall be as specified on the standard sheet. Requirements of 706-02 shall apply except that no determination of a 0.01 inch crack will be required and the ultimate strength values as determined on full length specimens shall be as specified on the standard sheet.

**Infiltration Requirements.** Pipe shall be tested for rate of infiltration in accordance with the method of test outlined in AASHTO Designation M176. The minimum rate of infiltration shall not be less than 1 gallon per minute per inch of internal diameter per foot of pipe for all sizes.

All tests shall be performed by the manufacturer at their plant and shall be witnessed by a representative of the Department. The number of samples for test shall be as directed by the Materials Bureau.

**Other Requirements.** In addition to the above tests, the pipe shall be subject to inspection at all times prior to placing and rejection will be made through failure to comply with any of the following conditions:

**A. Dimensions.** The pipe shall not vary in any dimensions more than permitted by this specification.

**B. Fractures or Cracks.** The pipe shall have no fractures or cracks passing through the shell or socket of the pipe, except that a single crack not exceeding 2 inches in length at either end of a pipe shall not be considered cause for rejection unless the defect exists in more than 5% of the lot offered for sampling and testing.

**C. Quality.** There shall be no defects that indicate imperfect mixing and molding.

**D. Strength.** There shall be no cracks that are sufficient to impair the strength, durability or serviceability of the pipe.

**E. Shape.** The shape of the pipe shall be such that there shall be no variation in alignment of more than 1/8 inch per linear foot.

**BASIS OF ACCEPTANCE.** The material will be considered for acceptance in stock lot quantities at the manufacturing location in accordance with procedural directives of the Materials Bureau.

In addition, the manufacturer shall furnish the Department representative at the plant a certification for each lot manufactured certifying that all pipe in the lot was manufactured in accordance with the terms

of this specification and that the pipe details conform to drawings previously approved by the Department. Pipe shall be considered ready for acceptance when a lot conforms to the indicated test requirements. The manufacturer shall be permitted to retest to determine specification compliance.

Pipe not used within two years after its original acceptance shall be retested by the Department before it can be used.

#### **706-06 (VACANT)**

#### **706-07 REINFORCED CONCRETE PIPE END SECTIONS**

**SCOPE.** This specification covers the material and fabrication requirements for reinforced concrete pipe end sections.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following, shall apply.

The barrel portion of the end section shall meet the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170 for Class III Pipe, Wall Designation B.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**MARKING.** The Marking requirements contained in §704-03 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

#### **706-08 POLYPROPYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for polypropylene pipe (PP) and fittings.

**GENERAL.** The corrugated polypropylene pipe covered by this specification is classified as follows:

1. Type S- This pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner liner. Corrugations shall be annular.
2. Type D- This pipe shall consist of an essentially smooth waterway braced circumferentially or spirally with projections or ribs joined to an essentially smooth outer wall. Both walls shall be fused to, or continuous with, the internal supports.



**MATERIAL REQUIREMENTS.** The polypropylene material for the pipe and fittings shall meet the requirements of AASHTO M330, Type S or Type D, and be in accordance with “Materials Method 30”. When checked with a 12 inch straight edge the smoothness of the interior liner shall not deviate more than ¼ inch.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by independent lab test results in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Approval and continued residence on the Approved List will also be subject to the requirements of “Materials Method 30”.

**BASIS OF ACCEPTANCE.** Polypropylene pipe will be accepted on the basis of the manufacturer’s name and location appearing on the Department’s Approved List. The approved Materials Details will be posted on the Department’s Approved List.

**706-09 CURED IN PLACE PIPE (CIPP) LINER**

(Last Revised May, 2016)

**SCOPE.** This specification covers the material requirements for cured in place pipe liners, or a resin and hardener system, used in rehabilitation of culverts and storm drains.

**GENERAL.** The flexible liner will be fabricated from one or more layers of polyester felt, or from an alternate material approved by the Director of the Materials Bureau. An impermeable material will be bonded to one or both sides of the liner. A styrene or a non styrene based thermoset resin and catalyst or an epoxy resin and hardener system, compatible with the proposed process or other system and/or process approved by the Materials Bureau must be used. If indicated in the contract documents, a resin (or other material approved by the Materials Bureau) containing less than five percent volatile organic compounds (VOCs) with less than 0.1 percent hazardous air pollutants (HAPs) and less than 0.1 percent of water quality pollutants *as listed in 6 NYCRR Parts 700-705* shall be supplied. The proposed resin must be compatible with the inversion process or other Materials Bureau approved installation process.

**MATERIAL REQUIREMENTS.** Supply a system material as described above, conforming to the following minimum values:

Property	Standard	Required*
Tensile Stress, psi	ASTM D638	2,500
Flexural Stress, psi	ASTM D790	4,500
Flexural Modulus, psi	ASTM D790	250,000

\* If the submitted design calculations indicate that higher values for the above listed material properties have been assumed, then the above listed values will become the minimum values for these liner material properties.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the Manufacturer or installer. This application will be accompanied by independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Approval and continued residence on the Approved list will also be subject to the requirements of the Materials Procedure “Approval Process for Cured in Place Pipe (CIPP) Liner (706-09)”

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's / installer's name appearing on the Approved List for Rehabilitation of Culverts and Storm Drains. Application for approval and entering into the aforementioned list shall be in accordance with the Materials Procedure, "Approval Process for Cured In Place Pipe (CIPP) Liner (706-09)".

#### **706-10 POLYVINYL CHLORIDE PIPE (relining)**

**SCOPE.** This specification covers the material requirements for polyvinyl chloride pipe when used in rehabilitation applications of culverts and storm drains.

**General.** The polyvinyl material from which the pipe and fittings are extruded or molded will not contain any reclaimed, reground or reworked material and will be comprised of virgin polyvinyl resins only. The resins used will meet the requirements contained in this specification. The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

**MATERIALS REQUIREMENTS.** The Polyvinyl Chloride pipe materials must conform to ASTM F1803 (Profile Wall), ASTM F949 (Corrugated), ASTM F679, or ASTM D3034. All materials supplied will be clearly marked with the appropriate ASTM as certified.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for Rehabilitation of Culverts and Storm Drains.

#### **706-11 HIGH DENSITY POLYETHYLENE PIPE (relining)** (Last Revised May, 2016)

**SCOPE.** This specification covers the material requirements for high density polyethylene pipe when used in rehabilitation applications of culverts and storm drains.

**GENERAL.** The high density polyethylene material from which the pipe and fittings are extruded will not contain any reclaimed, reground or reworked material and will be comprised of virgin high density polyethylene resins only. The resins used will meet the requirements contained in this specification. The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

**MATERIAL REQUIREMENTS.** The high density polyethylene pipe and its material must conform to ASTM F894 (Profile Wall) or ASTM F714 (Smooth Wall). All materials supplied will be clearly marked with the appropriate ASTM as certified. Sizes other than those listed within the tables of the ASTM specification will be allowed subject the approval of the director of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for rehabilitation of Culverts and Storm Drains.

#### **706-12 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for smooth interior corrugated polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of AASHTO M294, Type S or Type SP. In addition, when checked with a 12 inches straight edge the smoothness of the interior liner shall not deviate more than 1/4 inch.

**BASIS OF ACCEPTANCE.** Smooth interior, corrugated polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

The supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 10 days prior to shipment of the product to the job site.

### **706-13 PERFORATED CORRUGATED POLYETHYLENE UNDERDRAIN TUBING**

**SCOPE.** This specification covers the material and quality requirements for corrugated polyethylene tubing and fittings.

**MATERIAL REQUIREMENTS.** The corrugated polyethylene tubing and fittings 4 thru 10 inches in diameter shall meet the requirements of AASHTO Designation: M252, Corrugated Polyethylene Drainage Tubing except that tubing manufactured from material meeting A.S.T.M. Designation D1248, Class B, shall also be acceptable.

Corrugated polyethylene tubing and fittings 12 inches in diameter shall meet the requirements of AASHTO M252 except the pipe stiffness requirement shall be 45 psi at 5% deflection.

**BASIS OF ACCEPTANCE.** Perforated corrugated polyethylene underdrain tubing will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

### **706-14 CORRUGATED INTERIOR POLYETHYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for corrugated interior polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of AASHTO M294, Type C.

**BASIS OF ACCEPTANCE.** Corrugated interior polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

### **706-15 PVC PLASTIC DRAIN PIPE SYSTEM**

**SCOPE.** This specification covers the material and quality requirements for poly (vinyl chloride) plastic drain pipe, fittings and solvent cement when used as a drain pipe system.

**GENERAL.** The PVC material from which the pipe and fittings shall be extruded or molded shall not contain any reclaimed, reground or reworked material whatsoever, but shall be compounded from virgin PVC resins, plasticizers, stabilizers, and such materials that when compounded, it shall meet the requirements contained in this specification.

The pipe and fittings shall be extruded or molded in such a manner that all cross sections shall be dense, homogeneous, and free from porosity or other imperfections.

The solvent cement shall be a solution of unplasticized PVC tetrahydrofuran and cyclohexanone.

**MATERIAL REQUIREMENTS.** The PVC material for the pipe and fittings shall meet the requirements of ASTM D1784 for Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds, Class 12444-B.

The molded or extruded pipe shall conform to ASTM D1785 for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 80, PVC 1120.

The molded or extruded fittings shall conform to ASTM D2467 for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80, PVC I.

The solvent cement shall meet the requirements of ASTM D2564 for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

Nominal Size	Outside Diameter (Inches)	Inside Diameter (Inches)	Wall Thickness Schedule 80 (Inches)
4	4.500	3.826	0.337
5	5.563	4.813	0.375
6	6.625	5.761	0.432
8	8.625	7.625	0.500
10	10.750	9.564	0.593

**DIMENSIONS.** The dimensions and tolerances of the pipe and fittings shall conform to ASTM D1785 and D2467 respectively.

**MARKING.** All material furnished shall be plainly marked in accordance with ASTM D1785, D2467, and D2564 for the pipe, fittings and solvent cement, respectively.

**BASIS OF ACCEPTANCE.** All pipe, fittings and solvent cement shall be accepted on the basis of the manufacturer's certification that the material conforms to this specification.

**706-16 CELLULAR POLYSTYRENE PROTECTIVE COVER**

**SCOPE.** This specification covers the material and quality requirements for cellular polystyrene when used as protective cover for pipes.

**GENERAL.** The protective cover shall be fabricated from rigid extruded cellular polystyrene such that it shall meet the requirements contained in this specification.

The polystyrene shall be extruded in such manner that all cross sections shall be uniform and free from imperfections.

**MATERIALS REQUIREMENTS.** The fabricated cellular polystyrene protective cover shall meet the following requirements:

Property	ASTM Test Procedure	Requirement
Density, pcf	D1622	2.0 ± 0.15
Compressive Strength, psi	D1621	30 ± 5
Flammability	D635	Self-Extinguishing

**DIMENSIONS.** The protective cover shall be fabricated in cylindrical half-sections of any convenient length for application to straight pipe and half-sections of suitable shape and length to protect any non-linear portions of the pipe or fittings.

The thickness of the protective cover shall be maintained within  $\pm 1/16$  inch of the thickness shown on the plans.

The protective cover shall be fabricated such that it mates with the pipe without leaving gaps at the seams. It shall have the following maximum clearance between outside diameter of nominal pipe and inside diameter of protective cover:

Nominal Pipe Size, Inches	Maximum Clearance, Inches
1/8 to 1 1/2 incl.	1/64
2 to 4 incl.	2/64
5 to 11 incl.	5/64
12 and over	6/64

**BASIS OF ACCEPTANCE.** All protective cover furnished shall be marked with the following information: manufacturer's name, type of material, and nominal size.

All protective cover shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification.

### 706-17 PRECAST CONCRETE BOX CULVERTS

**SCOPE.** This specification covers the material and quality requirements for precast concrete box culverts.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein.

The concrete used to fabricate precast concrete box culverts shall have a minimum compressive strength of 5000 psi @ 28 days. Joint gasket material shall meet the requirements of ASTM D1056, Grade # 2A1 or # 2A2.

**DESIGN.** When the contract plans contain complete design details for the culvert, alternate designs will not be considered. When the contract plans do not contain complete design details for the culvert the Contractor shall be responsible for providing them. Precast concrete box culvert designs shall meet the requirements of Highway Design Manual Section 19.5 "*Design Guidelines for Reinforced Concrete Culverts*". Design details for bridge size culverts shall also include load rating information. The Load Rating shall be determined in accordance with the current AASHTO "Manual for Bridge Evaluation," with all interim provisions in effect. The contractor shall show which method (allowable stress or load factor) was used in load rating computations. Load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. The contractor shall include all load rating computations in the design calculation submittal. Design calculations shall be stamped by a Professional Engineer. The transmittal, processing and approval of box culvert designs will be in accordance with procedural directives of the Materials Bureau.

**DRAWINGS.** The Drawing requirements contained in §704-03, along with the following shall apply.

All fabrication drawings for Contractor provided designs shall be stamped by a Professional Engineer licensed, and registered, to practice in New York State. Fabrication drawings for bridge size culverts shall include load rating information. Reproducible drawings are required for bridge size culverts only.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply.

**Reinforcing.** Unless noted otherwise in the contract plans or approved fabrication drawings the concrete cover over reinforcing steel shall be 1 inch minimum on the walls, floor slab and roof slab of culverts and 1 1/2 inches minimum on wingwalls. When fill heights over the box culvert are less than 24 inches the concrete cover on the outside face of the roof slab shall be 2 inches minimum and all reinforcing steel in the top mat of the roof slab shall be epoxy coated or the concrete shall contain corrosion inhibitor. Fill heights shall be measured from the top of pavement to the top of the culvert roof slab. All reinforcing steel in the wall section of wingwalls shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**Joints.** Precast concrete box culvert sections shall be fabricated with a female joint on the upstream end and male joint on the downstream end. Joint depth shall be a minimum of 2 inches and a maximum of 4 inches. The ends of longitudinal reinforcing steel shall have 1/2 inch minimum concrete cover at the mating surface of the joint. The circumferential reinforcing steel shall have 1 inch minimum concrete cover, as measured to the outermost bars, at the mating surface of the joint. When interferences occur which prevent this, the concrete cover shall be increased accordingly as shown on the approved fabrication drawings. Joints shall be fabricated such that when box culvert sections are fully drawn together the gap between adjacent culvert sections is 3/4 inch maximum. The outside mating surface of the joint shall have a continuous 1 x 1 inch gasket installed at the precast plant.

**Corrosion Inhibitor.** Corrosion inhibitor may be used in lieu of epoxy coated reinforcing.

**Dimensional Tolerances**

- Internal Dimensions
  - < 48 inches: ±1/2 inch
  - ≥ 48 inches & ≤ 96 inches: ±3/4 inch
  - > 96 inches: ±1 inch
- Wall & Slab Thickness
  - < 10 inches: +5/8 inch, -1/4 inch
  - ≥ 10 inches: +3/4 inch, -1/4 inch
- Design Laying Length: +1 inch, -1/2 inch
- Variation in Laying Length of Opposite Faces
  - Span / Rise ≤ 84 inches: ±5/8 inch
  - Span / Rise > 84 inches: ±3/4 inch
- Surface Irregularities on Mating Surface of Joint (when checked with a 3 foot straight edge): ±1/4 inch

**Repair.** Minor defects in the mating surface of the joint, that do not come in contact with the joint gasket material and are 1/4 inch or less in depth, do not require repair.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein. Markings shall be placed on the inside face of one wall of each culvert barrel section.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 shall apply.

#### **706-18 PERFORATED POLYVINYL CHLORIDE UNDERDRAIN PIPE**

**SCOPE.** This specification covers the material and quality requirements for smooth-wall perforated polyvinyl chloride (PVC) plastic pipe, couplings and fittings intended for use in underdrains.

**MATERIAL REQUIREMENTS.** Perforated polyvinyl chloride underdrain pipe and fittings shall conform to AASHTO M278 Class PS46.

**BASIS OF ACCEPTANCE.** Acceptance of the perforated polyvinyl chloride underdrain pipe will be based on the manufacturer's certification of compliance with these specifications.

#### **706-19 FOR SITE MANAGER USE**

#### **706-99 FOR SITE MANAGER USE**

### **SECTION 707 - METAL PIPE**

(Last Revised May, 2019)

#### **707-01 (VACANT)**

#### **707-02 CORRUGATED STEEL PIPE**

**SCOPE.** The material requirements of corrugated steel pipe with metallic, bituminous, portland cement concrete/or polymer coating intended for use in construction of culverts and drainage systems.

**GENERAL.** The corrugated steel pipe covered by this specification is classified as follows:

1. Type I. A full circular cross-section, with a single thickness of corrugated sheet.
2. Type IR. A full circular cross-section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
3. Type II. A Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
4. Type IIR. A Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.
5. Type III. A Type I pipe which has been perforated to permit the in-flow or out-flow of water.

**MATERIAL REQUIREMENTS.** Apply the requirements of AASHTO M 36 Types I, IR, II, IIR, and III except as modified herein for all metallic coated corrugated steel pipe. Apply the requirements of AASHTO M190 except as modified herein for all bituminous coated corrugated steel pipe. Apply the requirements of AASHTO M 245 Types I and II except as modified herein for all polymer coated steel pipe.

When Type IR or Type IIR corrugated steel pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 3/4 x 3/4 inch at 7 1/2 inch pitch.

**A. Coatings .** Coat pipe with one of the following:

- 1. Metallic.** The steel sheet will have a protective coating of zinc galvanizing (AASHTO M 218) or of Aluminum-Coated (Type 2) (AASHTO M 274).

**2. Fully bituminous coated and paved invert (AASHTO M 190, Type C).** In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a bituminous paved invert.

**3. Fully bituminous coated and 100 percent paved (AASHTO M 190, Type D).** In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a fully paved, smooth bituminous interior.

**4. Polymer coated.** The steel sheet will have a protective coating of zinc (galvanizing). In addition, the pipe will have a minimum interior polymer coating thickness of 0.01 inch and an optional exterior polymer coating. If an exterior polymer coating is applied, it will have a minimum thickness of 0.003 inch.

**5. Polymer coated with a bituminous paved invert.** In addition to the zinc and polymer coatings, the pipe will have a bituminous paved invert.

<b>TABLE 707-2-1 SHEET GAGE NUMBERS AND THICKNESS OF UNCOATED METAL</b>			
<b>Manufacturer's Standard Gage #</b>	<b>Thickness Equivalent(*) Inches</b>	<b>Manufacturer's Standard Gage #</b>	<b>Thickness Equivalent(*) Inches</b>
1	0.27	15	0.067
2	0.25	16	0.060
3	0.24	17	0.054
4	0.224	18	0.048
5	0.21	19	0.042
6	0.20	20	0.036
7	0.18	21	0.033
8	0.164	22	0.030
9	0.150	23	0.027
10	0.134	24	0.024
11	0.120	25	0.021
12	0.104	26	0.018
13	0.090	27	0.016
14	0.074	28	0.015

\*NOTE: Minimum thickness shall conform to the appropriate AASHTO specifications.

**6. Portland Cement Concrete Lined.** The steel sheet will be covered with dense, homogeneous, nonsegregating concrete lining. The concrete will be a minimum thickness of 1/2 inch over the crest of the corrugations of the carrier pipe. In no case will the amount of portland cement, blended cement, or portland cement plus flyash be less than 17 pcf. Flyash in the mix may not exceed 20% by weight of the cementitious material. When type IP cement is used, no flyash will be added in batching. All concrete will have a water-cement ratio not exceeding 0.50 by weight. Cure the concrete lining prior to installation as per manufactures instructions.

The bituminous material for coating and/or paving will be homogeneous and have the following properties in addition to those specified by AASHTO M 190:

Penetration at 77°F, 100g, 5 seconds	AASHTO T49	25-50
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Penetration Ratio (40°F/77°F x 100)	AASHTO T49	80-90
Softening Point °F(Ball & Ring)	AASHTO T53	88-110

Apply the requirements of AASHTO M 246 for polymer material. Polymer coating materials must appear on the Department's Approved List.

Apply the material requirements of 501-2.02 Materials for portland cement concrete liner material.

**B. Gauge.** The nominal metal thickness corresponding to any gauge is shown in Table 707-2-1.

**C. End Finish.** To facilitate field joining, reroll the ends of all helical corrugated steel pipe with diameters of 12 inches or greater to form a minimum of two annular corrugations of no less than 2 2/3 inch pitch by 1/2 inch depth. Reroll the ends of Type IR and IIR pipe to form only two corrugations.

**D. Coupling Bands.** Supply annular corrugated steel coupling bands for all round pipe sections (Types I, IR, and III) 12 inches or greater in diameter. The band corrugations will have the same dimensions as the pipe ends. Mesh the band with at least one full corrugation and lap it equally on each pipe end. The band width will be a minimum of 7 inches for pipe diameters up to and including 32 inches. The band width will be a minimum of 10 1/2 inches for pipe diameters greater than 32 inches. The thickness of the band cannot be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.05 inch.

Pipe arches (Type II and IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands will consist of two rows of projections at 3 inches center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The thickness of the special projection bands will not be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.06 inch.

Regular projection type coupling bands (dimpled bands) will not be acceptable for 1 foot in diameter pipe and larger. Dimpled bands may be used on pipe diameters smaller than 1 foot, all sizes of perforated underdrain pipe (Type III), and for connecting pipe extensions to existing helical corrugated metal pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Use two piece coupling bands on pipe 48 inches or greater in diameter.

Use one of the following coupling band connectors:

- Galvanized steel angles, 2 x 2 x 3/16 inches
- Lug connectors
- Bar and strap connectors

Rivet, bolt, or weld these connectors to the coupling bands. Any evidence of loose bolts or rivets, bearing failure, or weld or band tearing are cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, a corrugated angle which conforms to an approved Materials Detail may be used.

Coat the steel sheet used for coupling bands with a polymer or metallic coating. If polymer or metallic coated corrugated steel pipe is being joined, the bands must have the same coating as the pipe.

Joints for concrete lined pipe will meet the requirements of ' 603-3.06 Joints.

**E. Coating Repair.** Repair damaged metallic, bituminous, portland cement concrete and/or polymer coating.

Metallic coating field repairs will be allowed only when the total damaged area on each piece is less than 2 sf of coated surface, excluding aluminum coated rerolled ends. Any piece having damaged areas totaling more than 2 sf, excluding aluminum coated rerolled ends, will be rejected. Repair metallic coatings as follows:

- Power disk sand or mechanically wire brush areas of damaged coating to bright metal
- Remove oil, grease, and corrosion products from repair areas
- Spray or brush a zinc-rich paint on clean, dry repair areas. The paint brand must appear on the Department's Approved List, Materials for Use in Repairing Galvanized Surfaces 719-01. The dry film paint thickness shall be at least 0.005 inch. Do not apply paint below 40°F.

Repair aluminum coatings damaged during rerolling at the manufacturing location. The rerolled ends may be either spot repaired or completely painted to repair small areas of damaged coating. Make repairs to the rerolled ends of aluminum coated pipe as referenced above. These rerolled end repairs, when properly completed, will not be counted toward the 2 sf of allowable damaged coating described above.

Repair damaged interior bituminous coatings using the original material or a Corrugated Metal Pipe Bituminous Coating Repair Material appearing in the Department's Approved List. Exterior damage to a bituminous coated pipe requires repair to the metallic coating only.

Repair damaged interior polymer coatings using Polymer Repair Materials for Steel Sheet used for Corrugated Pipe appearing in the Department's Approved List. Exterior damage to a polymer coated pipe requires repair to the metallic coating only.

Repair damaged portland cement concrete linings with Item 701-08, vertical and overhead patching material. The lining will be free of cracks exceeding 0.04 inch in width or the pipe will be rejected.

**F. Marking.** Mark or tag each length of corrugated steel pipe over the coating as approved by the Department to properly cross-reference the supplier's certification.

**G. Additional Defects.** In addition to coating damage and other criteria established in Materials Bureau procedural directives, the following additional defects along with those listed in AASHTO will be cause for rejecting the pipe when inspected at the project:

- Variation from a straight centerline of more than 3/4 inch in 20 feet.
- Any dents greater than 3 inches in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

**BASIS OF ACCEPTANCE.** Corrugated steel pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. Certification will accompany all shipments arriving at the project in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification will be rejected.

The Engineer will measure gauge and coating thicknesses at the project. The pipe will be rejected if the metal and/or coating thickness is less than required or certified. The Contractor will supply equipment required to measure metal and coating thicknesses as detailed in '603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval will be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

Polymer coatings, coating applicator facilities, and application methods are subject to Materials Bureau approval. Samples are required for laboratory and field testing. Field testing will be a minimum of two years duration. Upon approval, the brand of polymer coating and applicator will be placed on the Department's Approved List. Certifications for polymer coated pipe received at the project will include the brand and applicator of polymer coating, which must appear on the Department's Approved List. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

**707-03 DUCTILE IRON PIPE (NON-PRESSURE)**

**SCOPE.** This specification covers the material and quality requirements for 14 to 54 inches Ductile Iron Culvert Pipe.

**GENERAL.** Ductile Iron Pipe. (Non-Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ASTM A716, Ductile Iron Culvert Pipe.

**BASIS OF ACCEPTANCE.** Ductile Iron Pipe (Non-Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

**707-04 DUCTILE IRON PIPE (PRESSURE)**

**SCOPE.** This specification covers the material, and quality requirements for 3 to 54 inches Ductile Iron Pipe (Pressure).

**GENERAL.** Ductile Iron Pipe (Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ANSI A21.51., Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sandline Molds, for Water or Other Liquids.

**BASIS OF ACCEPTANCE.** Ductile Iron Pipe (Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

**707-05 TUNNEL LINER PLATE (RELINING)**

**SCOPE.** This specification covers the material and fabrication requirements for tunnel liner plate.

**MATERIAL REQUIREMENTS.** Tunnel liner plate steel must conform to ASTM A1011. Tunnel liner plate aluminum must conform to AASHTO M219 (ASTM B746). Before cold forming into tunnel liner plate the plates must conform to the following mechanical requirements:

	<b>STEEL</b>	<b>ALUMINUM</b>	
		<b>(0.125-0.15 in.)</b>	<b>(0.173-0.25 in.)</b>
Tensile Strength, psi	42,000 min.	35,000 min.	34,000 min.
Yield Point, psi	28,000 min.	24,000 min.	24,000 min.
Elongation in 2 inch, percent	30 min.	6 min.	8 min.

Prepare test specimens in accordance with ASTM A1011 for steel sheets or ASTM A283 for steel plates and ASTM B209M for aluminum plates. Deliver the Mill test reports, for each heat and thickness to the Engineer with each shipment of liner plates.

**Galvanizing.** Galvanize steel plates in accordance with AASHTO M167 M. Galvanize after the plates are formed, punched and curved. Hot dip galvanize all bolts and nuts, when used with galvanized tunnel liner plate in accordance with ASTM A153.

**Liner Plate.** Punch all plate for bolting on both the longitudinal and circumferential seams or joints and fabricate so as to permit complete erection from the inside of the tunnel liner plate structure. The minimum edge distance from the center of a bolt hole to the edge of a plate will be in accordance with the manufacturer's standard spacing. Provide a sufficient number of plates with 2 inches, or larger, grouting holes with pipe plugs, and spaced so that when the plates are installed there will be one line of holes at the crown of the pipe and one line on each side at approximately the midpoint. The holes in each line will not be more than 6 feet apart, and they will be staggered along the tunnel length.

**Tunnel Liner Plate (Two-Flange).** The minimum moment of inertia in inches<sup>4</sup> per inch of plate width, based on the average of one ring of plates is as follows:

<b>STEEL</b>		<b>ALUMINUM</b>	
<b>Uncoated</b>			
<b>Plate Thickness</b>	<b>Moment of Inertia</b>	<b>Thickness</b>	<b>Moment of Inertia</b>
<b>(in.)</b>	<b>(in.<sup>4</sup>/in.)</b>	<b>(in.)</b>	<b>(in.<sup>4</sup>/in.)</b>
0.135	0.064	0.125	0.0579
0.164	0.079	0.150	0.071
0.180	0.087	0.175	0.084
0.210	0.103	0.210	0.097
0.240	0.118	0.225	0.110

The longitudinal seams will be of the lap type. The depth of the offset will be equal to the thickness of the metal for the full width of plate, including flanges. Fabricate the lap to allow the cross section of the plates to be continuous through the seam. The lapped longitudinal joints will contain at least five (5) bolts per 18 inch plate width, with bolts in ridges and valleys staggered. Circumferential bolt spacing will be in accordance with the manufacturer's standard spacing and will be a multiple of the plate length so that the plates having the same curvature are interchangeable. Bolts and nuts for liner plate assemblies will not be less than 0.63 inch in diameter. Circumferential (flange) seams will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A and dimensions conforming to Grade B. Bolts and nuts for longitudinal seams will have square heads with a square shoulder to engage the plate. Longitudinal seams of plates 0.078 to 0.177 inches thick, inclusive will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A. Bolts for longitudinal seams of plates 0.2 to 0.25 inches or thicker will conform to the chemical and mechanical requirements of ASTM A449. Nuts, for use on ASTM A449 bolts, will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A, and dimensions conforming to Grade B.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List.

**707-06 THRU 707-08 (VACANT)**

## **707-09 CORRUGATED STRUCTURAL STEEL PLATE FOR PIPE, PIPE ARCHES AND UNDERPASSES**

**SCOPE.** This specification covers corrugated structural steel plates intended for use in the construction of pipe, pipe arches and underpasses.

**MATERIAL REQUIREMENTS.** Structural steel plate, nuts and bolts shall conform to the requirements of AASHTO M167 except as herein specified, and shall be of the thickness and shape shown of the plans. When a gauge number is specified in the contract documents it shall conform to Table 707-2-1.

Plates shall have approximately a 2 inch lip beyond each end crest, which will result in the actual length of a given structure being approximately 4 inches longer than the nominal length, except where skewed or beveled.

If directed by the Engineer, the Contractor shall, at its own expense, repair damaged spelter on plate items as directed under 719-01, Galvanized Coatings and Repair Methods. This repair method shall be allowed only when it is in the best interest of the Department. All repairs shall be made at no cost to the State.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. Certification format and fabrication shop approval shall be in accordance with procedural directives issued by the Materials Bureau. At the option of the Department, this material may be subjected to shop inspection.

## **707-10 GALVANIZED STEEL END SECTIONS**

**SCOPE.** This specification covers galvanized steel end sections to be attached to the inlet and outlet ends of corrugated steel pipe.

**MATERIAL REQUIREMENTS.** Galvanized steel end sections shall be manufactured from material meeting the requirements of AASHTO M218. The units shall conform to the shape, dimensions, and thickness shown on the applicable standard sheet and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking and coating repair shall meet the requirements of 707-02, Corrugated Steel Pipe.

**BASIS OF ACCEPTANCE.** End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives.

Shipments arriving without certification, or with improper certification, will be rejected.

Metal and coating thicknesses will be measured at the project by project inspectors. If the metal and/or coating thickness is less than required or certified, the material shall be rejected. Equipment required to measure metal and coating thickness shall be supplied by the contractor as detailed in '603-3.02G, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

## **707-11 ALUMINUM END SECTIONS**

**SCOPE.** This specification covers aluminum end sections to be attached to the inlet and outlet ends of corrugated aluminum pipe.

**MATERIAL REQUIREMENTS.** Aluminum end sections shall be manufactured from material meeting the requirements of AASHTO M197. The units shall conform to the shape, dimensions, and thickness shown on the standard sheet for galvanized steel end sections and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking shall meet the requirements of 707-13, Corrugated Aluminum Pipe.

**BASIS OF ACCEPTANCE.** End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with a certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, will be rejected.

Metal thickness will be measured at the project by project inspectors. If the metal thickness is less than required or certified, the material shall be rejected. Equipment required to measure thickness shall be supplied by the contractor as detailed in 603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

#### **707-12 (VACANT)**

#### **707-13 CORRUGATED ALUMINUM PIPE**

**SCOPE.** This specification covers corrugated aluminum pipe intended for use in the construction of culverts and drainage systems. The corrugated aluminum pipe covered by this specification is classified as follows:

**Type I.** This pipe shall have a full circular cross-section with a single thickness of corrugated sheet fabricated with annular (circumferential) or helical corrugations.

**Type IA.** This pipe shall have a full circular cross-section with an outer shell of corrugated sheet fabricated with helical corrugations and an inner liner of smooth (uncorrugated) sheet attached to the shell at helical lock seams.

**Type IR.** This pipe shall have a full circular cross-section with a single thickness of smooth sheet fabricated with helical ribs projecting outwardly.

**Type II.** This pipe shall be a Type I pipe which has been reformed into a pipe-arch having an approximately flat bottom.

**Type IIR.** This pipe shall be a Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.

**Type III.** This pipe, intended for use as underdrains or for underground disposal of water, shall be a Type I pipe which has been perforated to permit the in-flow or out-flow of water.

**MATERIAL REQUIREMENTS.** Corrugated aluminum pipe shall conform to the requirements of AASHTO M196 Types I, IA, IR, II, IIR, and III except as modified herein. When Type IR and Type IIR corrugated aluminum pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 3/4 x 3/4 inch at 7 1/2 inches spacing.

**Gauge.** The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1.

**End Finish.** To facilitate field joining, the ends of all helical corrugated aluminum pipe with 12 inches or greater diameters shall be rerolled to form a minimum of two annular corrugations of no less than 2 2/3 inch pitch by 1/2 inch depth. When the ends of Type IR or Type IIR pipe are rerolled, there shall be only two such corrugations. Rerolled pipe ends shall be uniquely and indelibly labeled so the pipe may be assembled in the field in the same order it was manufactured.

**Coupling Bands.** All round pipe sections (Types I, IA, IR, and III) 12 inches or greater in diameter shall be field joined with aluminum coupling bands. Helical corrugated pipe without rerolled ends may be joined with helical corrugated bands. Pipe with rerolled ends or annular corrugations shall be joined with annular corrugated coupling bands.

All bands shall have corrugations with the same dimensions as the pipe ends. Annular corrugated bands shall mesh with at least one full corrugation and shall lap equally on each pipe end. The band widths shall be a minimum of 7 inches for pipe diameters up to and including 32 inches. The band widths shall be a minimum of 10 1/2 inches for pipe diameters greater than 32 inches.

The bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.05 inch.

Pipe arches (Type II and Type IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands shall consist of two rows of projections at 3 inches center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The special projection bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.063 inch.

Regular projection type coupling bands (dimpled bands) will not be acceptable for pipe 12 inches in diameter and larger. Dimpled bands may be used on pipe smaller than 12 inches in diameter, all sizes of perforated underdrain pipe, and for connecting pipe extensions to existing helical corrugated pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Two piece coupling bands shall be used on pipe 48 inches or greater in diameter.

Coupling band connectors shall be one of the following types:

- Aluminum angles, 2 x 2 x 3/16 inches
- Aluminum lug connectors
- Aluminum bar and strap connectors.

These connectors shall be riveted, bolted, or welded to the coupling bands. Evidence of loose bolts or rivets, bearing failure, or weld or band tearing shall be cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, an aluminum corrugated angle which conforms to an approved Materials Detail may be used.

**MARKING.** Each length of corrugated aluminum pipe shall be marked or tagged as approved by the Department to properly cross-reference the supplier's certification.

**Additional Defects.** In addition to criteria established in Materials Bureau procedural directives and defects listed in AASHTO, the following defects will be cause for rejecting the pipe when inspected at the project:

- Variation from a straight centerline of more than 3/4 inch in 20 feet.
- Any dents greater than 3 inches in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

**BASIS OF ACCEPTANCE.** Corrugated aluminum pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, shall be rejected.

Gauge shall be measured at the project by project inspectors. If the gauge is less than required, the pipe shall be rejected. Equipment required to measure gauge shall be supplied by the contractor as detailed in ' 603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

#### **707-14 CORRUGATED ALUMINUM STRUCTURAL PLATE FOR PIPE AND PIPE ARCHES**

**SCOPE.** This specification covers corrugated aluminum structural plates for use in the construction of pipe and pipe arches.

**MATERIAL REQUIREMENTS.** Structural plate, nuts and bolts shall conform to the requirements of AASHTO M219 except as herein specified, and shall be of the thickness and shape shown on the plans. When a gauge number is specified in the contract documents, it shall conform to Table 707-2-1.

The corrugations shall run at right angles to the longitudinal axis of the structure. Plates shall have approximately a 1 3/4 inch lip beyond each end crest, which will result in the actual length of a given structure being approximately 3 1/2 inches longer than the nominal length, except where skewed or beveled.

All sections which are damaged from any cause, including handling, or where any dimension varies from that specified, shall be replaced at the Contractor's expense in a manner approved by the Engineer.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of certification by the fabricator. Each fabricator shall furnish upon request by the Materials Bureau a certified analysis and guarantee executed by the manufacturer of the base metal as described in AASHTO M219.

At the option of the Department, structural plates may be subjected to shop inspection or may be shipped to the project site accompanied by certified documentation executed in a form prescribed by the Department.

#### **707-15 THRU 707-19 (VACANT)**

#### **707-20 ANCHOR BOLTS FOR CORRUGATED CULVERTS**

**SCOPE.** This specification covers the material details and quality requirements for the anchorage system securing the ends of corrugated metal pipe, arch pipe, and structural plate to reinforced or plain concrete headwalls.

**MATERIAL REQUIREMENTS.** Anchor bolts shall be 3/4 inch diameter heavy hex bolts, ASTM A307. Grip shall be 5 1/2 inches threaded over at least the first 2 1/2 inches. The bolts shall be fitted with two nuts, ASTM A563 heavy hex. Nuts shall be chamfered on at least one face using a 1 inch spherical radii. The nuts and bolts shall be so assembled that in the final assembly, the bolt and one of the nuts is embedded in concrete, that the chamfered faces of the nuts face each other, and secure the pipe between them. Nuts and bolts shall be galvanized as per ASTM A153 after all machining operations are completed. Following galvanization, threads shall be cleaned to produce a free running fit.



When 19 inch hook bolts are used as anchor bolts they shall be detailed on the plans and shall conform to the requirements of ASTM A36.

Anchor bolts shall be spaced around the periphery of the pipe at intervals not exceeding 18 inches. At least two anchor bolts shall be provided.

**BASIS OF ACCEPTANCE.** Anchor bolts and nuts for corrugated metal pipes, pipe arches, and structural plate pipe will be accepted on the Manufacturer's Certification that they conform with these specifications.

## **707-99 FOR SITE MANAGER USE**

### **SECTION 708 - PAINTS**

#### **708-01 STRUCTURAL STEEL PAINTS CLASS 1**

(Last Revised January, 2021)

**SCOPE:** This specification defines the requirements for materials appearing on the Department's Approved List, "Structural Steel Paints, Class 1."

**MATERIAL REQUIREMENTS:** The system shall be able to be applied as a shop or a field-applied coating over an SSPC SP-10 cleaned surface.

The paint shall be a 3-coat system whose primer is an organic zinc-rich epoxy with pigment primarily consisting of zinc dust.

The paint shall have undergone National Transportation Product Evaluation Program (NTPEP) testing and meet North East Protective Coating Committee (NEPCOAT) Qualified Products List B approval criterion and the requirements of Materials Method NY 6 and 6 NYCRR Part 205. The coating manufacturer shall submit NTPEP results, field histories of the coating, Material Safety Data Sheets, and Technical Data Sheets to the Materials Bureau.

Any formulation or technical data sheet change may affect approval status and shall be reported to the Materials Bureau. Failure to notify the Materials Bureau shall result in the removal of the system from the Approved list.

The system's Technical Data Sheets shall contain the following information:

- Temperature Range for Storage
- Profile Range
- Temperature for Application
- Cure to Handle/Overcoat Schedule
- Humidity and Dew Point Restrictions
- Mixing Recommendations
- Thinners Allowed and Resulting VOC levels
- Recoat Window
- Paint Film Thickness Range, Wet- and Dry-Film Values
- Surface Preparation Requirements
- Application Requirements

If the data sheet does not have all of the above information, the manufacturer will be required to submit a letter to the Engineer with the above information. The letter will be considered an addendum to the technical data sheet. The manufacturer's data sheet, and addendum if applicable, will be posted on the

Department's Approved List, Structural Steel Paints, Class 1, as the official reference for New York State.

**BASIS OF ACCEPTANCE:** Contract acceptance will be based on the appearance of the product on the Approved List.

**708-02 STRUCTURAL STEEL PAINTS CLASS 2**  
(Last Revised January, 2021)

**SCOPE:** This specification defines the requirements for materials appearing on the Department's Approved List, "Structural Steel Paints, Class 2."

**MATERIAL REQUIREMENTS:** The system shall be able to be applied in the field over an SSPC SP-10 blasted or an SSPC SP-11 power tool cleaned surface, or a properly prepared, previously painted surface.

The paint shall have undergone National Transportation Product Evaluation Program (NTPEP) testing and meet (North East Protective Coating Committee) NEPCOAT Qualified Products List B approval criterion and the requirements of Materials Method NY 6 and 6 NYCRR Part 205. The coating manufacturer shall submit NTPEP results, field histories of the coating, Material Safety Data Sheets, and Technical Data Sheets to the Materials Bureau.

Any formulation or technical data sheet change may affect approval status and shall be reported to the Materials Bureau. Failure to notify the Materials Bureau shall result in the removal of the system from the Approved list.

The system's Technical Data Sheets shall contain the following information:

- Temperature Range for Storage
- Profile Range
- Temperature for Application
- Cure to Handle/Overcoat Schedule
- Humidity and Dew Point Restrictions
- Mixing Recommendations
- Thinners Allowed and Resulting VOC Levels
- Recoat Window
- Paint Film Thickness Range, Wet- and Dry-Film Values
- Surface Preparation Requirements
- Application Requirements

If the data sheet does not have all the above information, the manufacturer will be required to submit a letter to the Engineer with the above information. The letter will be considered an addendum to the technical data sheet. The manufacturer's data sheet, and addendum if applicable, will be posted on the Department's Approved List, Structural Steel Paints, Class 2, as the official reference for New York State.

**BASIS OF ACCEPTANCE:** Contract acceptance will be based on the appearance of the product on the Approved List.

**708-03 (VACANT)**

**708-04 ZINC CHROMATE PRIMER**

**SCOPE.** This paint is used as a prime coat on aluminum in contact with fresh concrete to reduce the effect of alkali attack.

**MATERIAL REQUIREMENTS.** The composition of this paint shall be as shown in the following table using ingredients conforming to the requirements of the applicable specifications indicated.

<b>Component</b>	<b>Specification</b>	<b>Lbs. Per 100 Gal.</b>
Zinc Yellow	(TT-P-465)	270
Titanium Dioxide, Rutile,	Chalk Resistant	75
Zinc Oxide (American Process Type)	(ASTM D79)	95
Sienna, Raw	(ASTM D765)	25
Magnesium Silicate	(ASTM D605)	75
Aluminum Stearate	(MIL-A-15206A)	6.0
Resin, alkyd Solution	(TT-R-266C, Type I)	345
Dipentene	(TT-D-376)	22.0
Petroleum Spirits	(TT-T-291, Type I, Grade A)	235
Lead Napthenate	(ASTM D600, Class B)	12.0
Cobalt Napthenate	(ASTM D600, Class B)	1.2
Magnesium Napthenate	(ASTM D600, Class B)	1.2

The quantitative requirements of zinc chromate primer shall be as follows:

	<b>Min.</b>	<b>Max.</b>
Pigment	45.0%	49.0%
Vehicle	51.0%	55.0%
Volatile by weight of paint	29.5%	33.5%
Weight (lb/gal)	11.0	11.6
Water	-	0.5%
Coarse particles & skins (total residue retained on 45 um sieve based on paint)	-	0.5%
Fineness of Grind (North Standard)	4	-
Viscosity at 25°C (Stormer-Krebs Units)	62	82
Zinc oxide (ZnO), by weight of pigment	34.0%	39.0%
Titanium Dioxide (TiO <sub>2</sub> ), by weight of pigment	12.0%	14.5%
Chromium Trioxide (CrO <sub>3</sub> ), by weight of pigment	20.0%	-
Phthalic Anhydride, by weight of non-volatile vehicle	23.0%	-
Flash Point	86°F	-

The percentages noted relate to mixture by weight. The paint shall dry set to touch within two hours and dry hard within 6 hours. No resin and resin derivatives shall be present in the paint. The paint shall show no evidence of cracking when subjected to a 1/8 inch “mandrel flexibility test.”

**708-05 STANDARD PAINT COLORS**

(Last Revised January, 2021)

**SCOPE:** This specification defines commonly used colors.

**DEFINITIONS:**

Color Reference Standard	
Sage Green Paint	Munsell 7.5 GY 5/4
Light Gray Paint	Munsell 10B 6/1
Blue Paint	AMS-STD-595, #35177
Brown Paint	AMS-STD-595, #30111
Brown-Gray Paint	AMS-STD-595, #36306
Dark Blue Paint	AMS-STD-595, #15090
Textured Concrete Finish Paint	AMS-STD-595, #36440
Weathered Brown Guide Rail Paint	AMS-STD-595, #20059

Assistance in providing definitions for other colors is offered by the Materials Bureau.

**BASIS OF ACCEPTANCE:** The Engineer may require manufacturer's certification that the color provided meets the requirements of this specification.

**708-06 PAINT FOR GALVANIZED SURFACES**  
(Last Revised January, 2021)

**SCOPE.** This specification covers the materials requirements for paints to be applied over galvanized surfaces.

**PAINT.** Paint shall be a two-coat system with a polyamide epoxy primer and an aliphatic urethane, suitable for exterior use. The paints shall have a VOC level below the maximum allowable limit set by 6 NYCRR Part 205, shall be produced by the same manufacturer, and the prime and topcoat shall be compatible. The primer shall be specifically formulated for use over galvanized surfaces.

**BASIS OF ACCEPTANCE.** The material shall be accepted with the submission of the technical data sheets and the manufacturer's certification ensuring compliance with this specification.

**708-07 PAINT FOR ALUMINUM SURFACES**  
(Last Revised January, 2021)

**SCOPE.** This specification covers the materials requirements for paints to be applied over aluminum surfaces not in contact with concrete.

**PAINT.** Paint shall be a two-coat system with an epoxy primer and an aliphatic urethane, suitable for exterior use. The paints shall have a VOC level below the maximum allowable limit set by 6 NYCRR Part 205, shall be produced by the same manufacturer, and the prime and topcoat shall be compatible. The primer shall be specifically formulated for use over aluminum surfaces.

**BASIS OF ACCEPTANCE.** The material shall be accepted with the submission of the technical data sheets and the manufacturer's certification ensuring compliance with this specification.

**708-08 THRU 708-30 (VACANT)**

## **708-31 WOOD PRESERVATIVE – WATERBORNE**

(Last Revised September, 2021)

**SCOPE.** These specifications cover waterborne wood preservatives used in the treatment of piles, timber, and lumber.

**MATERIAL REQUIREMENTS.** Waterborne preservative used in the treatment of piles, timber and lumber shall conform to the requirements of AWPA's use Categories: UC2, UC3, UC4 and UC5 and with the relevant P Standards for each preservative system. The method of application shall be in accordance with the T1 Processing and Treatment Standard. Minimum net retention shall be as required for material in contact with soil.

As an alternative to AWPA Standards, wood, and wood-based materials (waterborne or oil-borne) may be treated in conformance with the Acceptance Criteria for Proprietary Wood Preservative Systems (AC326) of the International Code Council-Evaluation Service, Inc. (ICC-ES).

Treatment of wood materials with Chromated Copper Arsenate (CCA) is restricted, in accordance with:

- September 2008 Re-registration Eligibility Decision for Chromated Arsenicals, issued by the U.S. Environmental Protection Agency (USEPA)
- Section 37-0109 of the NYS Environmental Conservation Law (ECL)

Unless allowed in the Contract Documents, CCA shall not be used.

**BASIS OF ACCEPTANCE.** Waterborne wood preservatives will be accepted on the basis of a material certification ensuring compliance with this specification and with AASHTO Standard Specification M-133 *Preservatives and Pressure Treatment Processes for Timber*.

## **708-32 WOOD PRESERVATIVE – OIL-BORNE**

(Last Revised September, 2021)

**SCOPE.** These specifications cover oil-borne wood preservatives used in the treatment of timber and lumber.

**MATERIAL REQUIREMENTS.** Pentachlorophenol and Copper Naphthenate shall conform to American Wood Protection Association Standards P35 and P36, respectively, and diluted in oils conforming to Standards Hydrocarbon Solvent Standard A (HSA) or Hydrocarbon Solvent Standard G (HSG).

Oil-borne wood preservatives shall be applied in conformance with the Use Category Designations UC3, UC4, or UC5 of the U1-20 User Specification for Treated Wood Standard of the American Wood Protection Association. The method of application shall be in accordance with the T1 Processing and Treatment Standard. Minimum net retention shall be as required for material in contact with soil.

**BASIS OF ACCEPTANCE.** Oil-borne wood preservatives will be accepted on the basis of a material certification ensuring compliance with this specification and with AASHTO Standard Specification M-133 *Preservatives and Pressure Treatment Processes for Timber*

## **SECTION 709 - REINFORCING STEEL**

(Last Revised May, 2019)

## 709-01 BAR REINFORCEMENT, GRADE 60

**SCOPE.** This specification covers the material requirements for deformed billet steel and deformed rail steel reinforcing bars used in portland cement concrete. Plain and deformed steel for the fabrication of spirals is included.

### MATERIALS REQUIREMENTS

**A. Deformed Bar Reinforcement.** Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615, Grade 60, or deformed rail steel bars meeting the requirements of ASTM A996/996M, Grade 60.

**B. Spirals.** Spirals shall be plain wire meeting the requirements of ASTM A1064, or plain or deformed bars in coils or cut lengths, meeting the requirements of ASTM A615, Grade 60.

When specified the spirals shall be epoxy coated in accordance with the applicable requirements of 709-04 or 709-08.

**BASIS OF ACCEPTANCE.** Bar reinforcement and spirals will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

## 709-02 WIRE FABRIC FOR CONCRETE REINFORCEMENT

**SCOPE.** This specification covers the material requirements for wire fabric reinforcement used in portland cement concrete pavement, precast concrete products and other concrete construction.

**MATERIALS REQUIREMENTS.** Wire fabric reinforcement shall conform to the requirements of ASTM A1064, exclusive of the portions pertaining to rejection, retests and rehearing, except as indicated on the plans, in the proposal or as modified herein.

The weld shear test will not be required for acceptance of wire fabric for concrete pipe.

**BASIS OF ACCEPTANCE.** Welded wire fabric for concrete reinforcement will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

## 709-03 FOR SITE MANAGER USE

## 709-04 EPOXY-COATED BAR REINFORCEMENT

**SCOPE.** This specification covers bar reinforcement with protective epoxy coatings applied by the electrostatic spray method.

### MATERIAL REQUIREMENTS

**A. Bar Reinforcement.** Steel reinforcing bars shall conform to the requirements of §709-01, Bar Reinforcement, Grade 60 or §709-14, Bar Reinforcement, Grade 75.

**B. Epoxy Coating Material.** The epoxy coating material shall be an organic, powdered-epoxy resin that is applied by electrostatic methods.

Epoxy coating material shall be approved by the Materials Bureau. Detailed requirements and procedures for the acceptance of epoxy coating materials are available from the Materials Bureau.

Upon approval of the product, the epoxy coating will be placed on a Department "Approved List" of materials. The epoxy coating manufacturer shall supply written certification to the coating applicator that the coating material is the same as that approved by the Materials Bureau.

**C. Patching Material.** Patching or repair materials shall be supplied by the epoxy coating manufacturer. The patching material shall be compatible with the epoxy coating, inert in concrete, and suitable for use in making shop or field repairs.

## **Coating Application**

**A. Coating Applicator.** The coating applicator's facilities shall be approved by the Materials Bureau. Applications for approval of facilities shall be made to the Materials Bureau by the coating applicator. Upon approval, the name and address of the coating applicator will be placed on the Department's list of "Approved Applicators."

### **B. Surface Preparation**

1. The surface of bars to be coated shall be blast cleaned in accordance with the Steel Structures Painting Council - Surface Preparation Specification No. 10 (SSPC-SP10), Near White Blast Cleaning. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis 1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable.
2. A suitable anchor pattern shall be produced by the cleaning media. A target profile of approximately (1/3) the coating thickness shall be considered suitable as an anchor pattern. Measurements shall be taken using a surface profile gage, or replica tape, approved by the Materials Bureau.
3. The powdered epoxy resin coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation occurs. In no case shall more than 8 hours elapse between cleaning and coating.

**C. Coating Application.** The powdered epoxy resin coating shall be electrostatically applied to pre-heated bars, and cured in accordance with the recommendations of the coating manufacturer. The epoxy coating may be applied before or after fabrication (bending) of the reinforcement bars.

### **D. Coating Thickness**

1. The epoxy coating shall be applied as a uniform, smooth coat. After curing, the coating thickness shall be  $10 \pm 2$  mils.
2. Coating thickness shall be determined by taking measurements on a minimum of five coated bars from each production lot. Five spot measurements shall be obtained from evenly spaced locations along each side of the test bar (a minimum of 10 spot measurements per bar). A spot measurement is defined as the average of three individual readings obtained from three adjacent areas on the body, or on the deformations of the bar.
3. For acceptance purposes at least ninety (90) percent of all spot thickness measurements shall be 8 to 12 mils after cure, and no spot measurement of coating thickness shall be less than 8 mils or greater than 15 mils.
4. Coating thickness shall be measured by the method outlined in ASTM G12, except that the number and location of thickness measurements shall be in accordance with this specification. All magnetic gages shall be approved by the Materials Bureau.

### **E. Continuity of Coating**

1. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.
2. The coating shall have not more than two holidays (pinholes not visible to the naked eye) in any 1 foot length of the coated bar. A 67.5 volt, 80,000 ohm, d-c holiday detector shall be used in-line to check the coating for holidays at all times during the application of epoxy protective coating. Bar reinforcement that is coated when the in-line detector is inoperable shall be automatically rejected.

**F. Coating Cure.** The coating applicator shall check each production lot to determine that the entire production lot of coated bars is in a fully-cured condition.

**G. Adhesion of Coating**

1. The adhesion of the coating shall be evaluated on a minimum of two bars from each production lot. The coated bar shall be bent 120 degrees (after rebound) around a mandrel of specified size as designated in Table 709-4. The bend shall be done at a uniformly slow rate and may take up to 45 seconds to complete. The bend test specimen shall be positioned so that the two longitudinal deformations are in a plane perpendicular to the mandrel radius. The test specimens shall be between 68°F and 86°F at the time of testing.
2. No cracking, disbondment, or other coating defect shall be visible to the naked eye on the outside, or on the inside radius of the bent bar.
3. If both test specimens show evidence of cracking or disbondment, the production lot represented by the samples shall be rejected.

If only one of the two test specimens shows evidence of cracking or disbondment of coating, two additional random samples shall be tested. If the test results from both retests show no defects, the production lot represented by the samples shall be accepted. If the test results of either retest fails, the production lot represented by the samples will be rejected.

<b>TABLE 709-4 BEND TEST REQUIREMENTS</b>											
Bar Number	3	4	5	6	7	8	9	10	11	14	18
Mandrel Diam. (in.)	3	4	5	6	7	8	9	10	11	17	23

**NOTE:** Bar Numbers are bar sizes marked in eighths of inches

**SAMPLING AND TESTING**

**A. Lot Size.** For test purposes a production lot is the smallest number of reinforcement bars of the same type, heat and size as determined by the following requirements:

1. A lot shall not exceed a single order.
2. A lot shall consist of the number of bars as defined by the coating applicator, except that it shall not exceed the number of reinforcement bars coated within a single working shift.

**B. Quality Control.** The coating applicator shall be responsible for performing quality control and test. This will include inspection for compliance with the requirements of Coating Thickness, Continuity of Coating, and Coating Cure, and the testing required under Adhesion of Coating.

**C. Plant Inspection**

1. The Department reserves the right to have its authorized representative observe the preparation, coating, and testing of the reinforcement bars. The representative shall have free access to the plant. Any work done when access has been denied shall be automatically rejected.



2. If the representative elects, lengths of coated bars may be taken from the production run, on a random basis, for test, evaluation and check purposes by the Materials Bureau.

## Repair of Coated Bars

### *A. Repairs at the Coating Applicator's Facility*

1. Repairs will not be allowed on epoxy-coated reinforcement bars that do not meet the requirements for Coating Thickness, Continuity of Coating, Coating Cure, or Adhesion of Coating. Reinforcement bars exhibiting any one of these defects shall be replaced, or stripped of epoxy coating, recleaned, and recoated in accordance with this specification.
2. All other damage that occurs from handling, or for other reasons, at the coating applicator's facility shall be repaired with patching material. All repairs shall be performed as soon as possible and before visible rust (oxidation) appears on the steel surface. All repairs shall be performed in accordance with the recommendations of the manufacturer of the patching material.
3. The coating applicator shall be responsible for repair to the coating due to damage at the coating applicator's facility.

### *B. Repair at the Fabrication Facility*

1. The fabricator shall be responsible for repair to the coating due to damage during fabrication and handling at the fabricator's facility.
2. All coating damage due to fabrication, or handling, or for other reasons that occurs at the fabricator's facility shall be repaired with patching material.
3. Wherever bond loss or damaged areas of coating exist, they shall be cleaned and repaired. The cleaning shall remove loose or deleterious material, or both. In cases where rust is present it shall be removed by blast cleaning prior to repairs. The requirements of Surface Preparation, part 2a., shall apply.
4. Visible cracks, including hairline cracks without bond loss that occur due to fabrication of the bars, shall be repaired with patching material.
5. When coated bars are sheared, saw-cut, or cut by other means during the fabrication process, the exposed ends shall be coated with patching material.
6. All repairs shall be performed as soon as possible and before visible rust (oxidation) appears on the steel surface.

**HANDLING AND STORAGE.** All systems for handling coated bars shall have padded contact areas for the bars. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports or a platform bridge so as to prevent bar to bar abrasion from sags in the bar bundle. The bars or bundles shall not be dropped or dragged.

Epoxy-coated bar reinforcement shall be stored above the ground on wooden or padded supports. Epoxy-coated bar reinforcement shall not be stored unprotected outdoors. All coated bars that are stored outdoors shall be protected from sunlight and moisture, using opaque waterproof covers. The covers shall be placed in a manner that will permit constant air circulation so as to minimize the formation of condensation on the epoxy-coated bar surface.

**BASIS OF ACCEPTANCE.** Epoxy-coated bar reinforcement, grade 60 or grade 75, will be accepted on the basis of the names and locations of the reinforcing bar manufacturer and the epoxy reinforcing bar applicator appearing on the Department's Approved List and a material certification from the epoxy reinforcing bar applicator that specifies the product conforms to this specification. In addition, fabricated, epoxy-coated bar reinforcement will be supplied by a fabricator appearing on the Department's Approved List, Fabricators for Epoxy-Coated Steel Reinforcing Bars. *Buy America requirements apply.*

## **709-05 STUD SHEAR CONNECTORS**

**SCOPE.** This specification covers the material requirements for stud shear connectors used in bridge structures.

**MATERIALS REQUIREMENTS.** Steel used for the manufacture of stud shear connectors shall conform to the Specification for Steel Bars, Carbon, Cold Finished, Standard Quality, ASTM A108, UNS Designation G10100 thru G10200, either Semi-Killed, or Killed Deoxidation.

Stud shear connectors shall be furnished in the dimension shown on the Contract Plans.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

ASTM quality control tests shall have been made not more than six months prior to the date of manufacture of the studs.

## **709-06 LOW-RELAXATION PRESTRESSING STEEL, GRADE 270**

**SCOPE.** This specification covers the material requirements for low-relaxation prestressing steel used in the fabrication of prestressed concrete units.

**MATERIAL REQUIREMENTS.** Low-relaxation prestressing steel shall conform to the requirements of ASTM A416M, Grade 270. Low-relaxation prestressing steel shall be free of dirt, oil, paint, mill scale, corrosion, coatings, lubricants, or any other foreign material that may prevent an acceptable bond between the steel and the concrete.

**BASIS OF ACCEPTANCE.** Low-relaxation prestressing steel will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

## **709-07 STONE CURB ANCHOR BARS**

**SCOPE.** This specification covers the material requirements for stone curb bars used in bridge construction.

**MATERIAL REQUIREMENTS.** Anchor bars for Types F1, G1, M, R1, R2, S and T1 curbs shall meet the requirements of ASTM A615, Grade 60 or Grade 75, deformed billet-steel bars shall be galvanized in accordance with ' 719-01, Galvanized Coatings and Field Repair Methods, Type I. As an alternate to galvanizing, the bars may be treated with a protective epoxy coating. This coating shall be applied by either the electrostatic spray method or the electrostatic fluidized bed method, as specified in ' 709-04 Epoxy Coated Bar Reinforcement or in accordance with the applicable requirements of ' 705-14 Longitudinal Joint Ties.

**BASIS OF ACCEPTANCE.** The stone curb anchor bars will be accepted when on the basis of evaluation by the Engineer, the product complies with these specification requirements.

## **709-08 EPOXY COATED WIRE FABRIC REINFORCEMENT**

**SCOPE.** This specification covers sheets of wire fabric reinforcement with protective epoxy coatings that are applied by the electrostatic spray method or electrostatic fluidized bed method.

## MATERIAL REQUIREMENTS

**A. Wire Fabric Reinforcement.** Wire fabric reinforcement shall conform to the requirements of 709-02.

### **B. Epoxy Coating Material**

1. The epoxy coating material shall be an organic, powdered epoxy resin that is applied by electrostatic methods. Epoxy coating materials shall be approved by the Materials Bureau. Detailed requirements and procedures for the acceptance of epoxy coating materials are available from the Materials Bureau. Upon approval of the product, the epoxy coating will be placed on a Department Approved List of materials.
2. The epoxy coating manufacturer shall supply written certification to the coating applicator that the coating material is the same as that approved by the Materials Bureau.

**C. Patching Material.** Patching or repair materials shall be supplied by the epoxy coating manufacturer. The patching material shall be compatible with the epoxy coating, inert in concrete, and shall be suitable for use in making field repairs.

## Coating Application

**A. Coating Applicator.** The coating applicator's facilities shall be approved by the Materials Bureau. Applications for approval of facilities shall be made to the Materials Bureau by the coating applicator. Upon approval, they will be placed on the Department's list of "Approved Applicators For Epoxy Coated Wire Fabric Reinforcement."

### **B. Surface Preparation.**

1. The surface wire fabric to be coated shall be blast cleaned in accordance with the Steel Structures Paint Council - Surface Preparation Specification No. 10 (SSPC-SP10), near White Blast Cleaning. After blasting, the cleaned surface of the bar shall be defined by SSPC-Vis 1-89, Pictorial Standards A SP 10, B SP 10, or C SP 10, as applicable.
2. The powdered epoxy resin coating shall be applied to the cleaned surface as soon as possible after cleaning and before visible oxidation occurs. In no case shall more than 8 hours elapse between cleaning and coating.

**C. Coating Application.** The powdered epoxy resin coating shall be electrostatically applied in accordance with the recommendations of the coating manufacturer.

**D. Coating Thickness.** The epoxy coating shall be applied as a smooth, uniform coat. After curing, the coating thickness shall be a minimum of 4 mils. Coating thickness shall be controlled by taking measurements on a representative sample from each production lot. Coating thickness measurements shall be conducted by the method outlined in ASTM B499.

### **E. Continuity of Coating**

1. The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks and damaged areas.
2. The coating shall not have more than two holidays (pinholes visible to the naked eye) in any 1 foot length of a coated single wire. A holiday detector shall be used, in accordance with the manufacturer's instructions, to check the coating for holidays. Sharp edges at the welded intersection of the wires shall not be considered to be holidays.

**F. Coating Cure.** The coating applicator shall check each production lot to determine that the entire production lot of coated fabric is in a fully-cured condition.

**G. Flexibility of Coating**

1. The flexibility of the coating shall be evaluated on two representative sections of wire fabric from each production lot or two #16, Grade 60 reinforcing bars that have been coated simultaneously with the wire fabric. A representative wire from the wire fabric shall be bent 120 degrees (after rebound) around a pin or mandrel of 10 diameters or alternately, a reinforcing bar shall be bent 120 degrees around a 6 inch diameter pin or mandrel. Bending shall be done at a minimum rate and may take up to one minute to complete. The test specimens shall be a thermal equilibrium between 68<sup>o</sup> and 86<sup>o</sup>F at the time of testing.
2. When examined by the naked eye, the outside radius of the bent wire or bar shall be free of cracks in the coating.

**TESTING AND SAMPLING**

**A. Lot Size.** For test purposes a production lot is the smallest number of sheets of wire fabric of the same style (gauge, spacing size) from a given manufacturer as determined by the following requirements:

1. A lot shall not exceed a single order, or delivered load of 1500 sheets, whichever is smaller.
2. A lot shall consist of the number of sheets as defined by the coating applicator except that it shall not exceed the number of sheets coated within a single working shift.
3. A lot shall consist of the number of sheets of mesh coated with the same batch or lot of epoxy.

**B. Quality Control.** The coating applicator shall be responsible for performing quality control and tests. This will include inspection for compliance with the requirements of Coating Thickness, Continuity of Coating and Coating Cure and the testing required under Flexibility of Coating.

**C. Plant Inspection.**

1. The Department reserves the right to have its authorized representative observe the preparation, coating and testing of wire fabric. The representative shall have free access to the plant. Any work done while access was denied will be rejected.
2. If the representative elects, samples of coated fabric may be taken from the production run, on a random basis, for test, evaluation and check purposes by the Materials Bureau.

**REPAIR.** Epoxy coated wire fabric reinforcement which does not meet the requirements of Coating Thickness, Continuity of Coating, Coating Cure or Flexibility of Coating shall not be repaired.

Reinforcement with these defects shall be replaced or stripped of epoxy coating, recleaned and recoated in accordance with the requirements of this specification.

Any damage to the coated reinforcement, occurring at the coating applicator's facility shall be cleaned and repaired with patching material. The cleaning shall remove loose or deleterious material or both. If rust is present, it shall be removed by blast cleaning prior to patching.

**HANDLING.** All systems for coated wire fabric shall have padded contact areas, wherever possible. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports or a platform bridge so as to prevent sheet to sheet abrasion from sags in the bundle. The sheets or bundles shall not be dropped or dragged.

**BASIS OF ACCEPTANCE.** Epoxy-coated wire fabric will be accepted on the basis of the names and locations of the welded wire fabric manufacturer and the epoxy applicator appearing on the Department's

Approved List and a material certification from the epoxy applicator that specifies the product conforms to this specification. *Buy America requirements apply.*

#### **709-09 COLD-DRAWN WIRE FOR CONCRETE REINFORCEMENT**

**SCOPE.** This specification covers the material requirements for cold-drawn wire for concrete reinforcement used in portland cement concrete pavement, precast concrete products and other concrete construction.

**MATERIAL REQUIREMENTS.** Cold-drawn wire shall conform to the requirements of ASTM A1064, exclusive of the portions pertaining to rejection, retests and rehearing, except as indicated on the plans or in the proposal.

**BASIS OF ACCEPTANCE.** Cold-drawn wire will be considered for acceptance on the basis of the Manufacturer's name appearing on the Approved List and certification in accordance with procedural directives of the Materials Bureau.

Alternately, cold-drawn wire from a Manufacturer not appearing on the Approved List may be considered for acceptance in stock lot quantities at manufacturing locations based on sampling and testing in accordance with procedural directives of the Materials Bureau.

#### **709-10 MECHANICAL CONNECTORS FOR REINFORCING BAR SPLICES**

**SCOPE.** This specification covers the material requirements for mechanical connectors for splicing reinforcing bars.

**GENERAL.** Mechanical connectors for use on epoxy coated reinforcing bars shall be epoxy coated. Mechanical connectors coated prior to installation shall be coated in conformance with the applicable requirements for epoxy coatings contained in 709-04, Epoxy Coated Reinforcement. Mechanical connectors coated after installation shall be coated with an epoxy repair material compatible with the reinforcing bar epoxy coating. The assembled connection on epoxy coated reinforcing bars shall have no exposed uncoated steel. Any damage to the epoxy on the mechanical connector or reinforcing bars shall be repaired with a compatible epoxy repair material.

Mechanical connectors used on Galvanized Bar Reinforcement shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods.

Mechanical connectors for Stainless Steel Reinforcement shall be fabricated from any alloy of stainless steel that is on the Approved List for 709-13. Connectors must be made from the same alloy of stainless steel as the bars they are connecting.

**MATERIAL REQUIREMENTS.** Mechanical connectors will be tested for the following three parameters:

- The maximum slip, at 50% of the yield strength of the reinforcing bar, shall be 0.010 inch. At least 70% of the maximum slip shall have occurred on the first cycle.
- The maximum slip, at 90% of the yield strength of the reinforcing bar, shall be 0.018 inch.
- The tensile strength of the splice shall be at least 90% of the specified minimum tensile strength of the reinforcing bar.

**BASIS OF ACCEPTANCE.** Mechanical connectors for Reinforcing Bar Splices will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that states the product conforms to this specification or, at the discretion of the Department, based on sampling and testing in accordance with the procedural directives of the Materials Bureau. *Buy America requirements apply.*

## 709-11 GALVANIZED BAR REINFORCEMENT

**SCOPE.** This specification covers bar reinforcement with a hot dipped galvanized coating. Bar reinforcement will be coated before or after bending, as required by the payment specification.

### MATERIAL REQUIREMENTS

**A. Reinforcing Steel.** The material for the reinforcing steel shall meet the requirements of '709-01 Bar Reinforcement , Grade 60 or §709-14, Bar Reinforcement, Grade 75.

**B. Galvanizing.** The bar reinforcement shall be galvanized in accordance with ASTM A767 “Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement” to a Class I Coating.

**C. Embrittlement Testing.** The coating applicator shall take the necessary precautions to prevent embrittlement by conforming to the requirements of STM A143 “Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement”. The test for embrittlement shall be conducted by the coating applicator or his representative according to the bend test described in ASTM A615 “Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement”. The coating applicator shall include one reinforcing bar test specimen at least 3 feet long for each lot for this testing. The test specimen shall have the same diameter as the lot members and shall be quenched, and galvanized in the same manner and at the same time as the bars whose characteristics it is intended to represent. If the test specimen cracks or otherwise fails the bend test, the entire lot it represents shall be rejected. For test purposes, a lot is any one of the following:

- Reinforcing bars of the same diameter comprising a single order
- A number of reinforcing bars of the same diameter identified as a lot by the coating applicator, providing the bars are all been coated within a single production shift
- One thousand reinforcing bars of the same diameter. Notwithstanding the above two, no lot shall exceed one thousand bars.

**D. Identification.** The Contractor shall coordinate the tagging and identification requirements for the project and for lot identification and shall provide a non-destructive metal tag system for bent reinforcing bars.

**E. Inspection.** The materials Bureau shall be notified 30 days prior to the beginning of the coating application. The Materials Bureau representative and any other Department authorized representative shall have free access to the plant for inspection. Work done while any Department representative has been refused access shall be automatically rejected.

If the Department representative so elects, preparation of the bars, quenching and coating shall be done in his presence. On a random basis, lengths of coated bars may be taken by the representative from the production run at the point of coating application for test, evaluation and check purposes.

**F. Zinc Rich Paint.** Zinc rich paint used for field repairs of galvanized coatings shall meet the following requirements:

- One application of the material shall provide a dry film thickness of 2 mils
- The dried fill shall have a minimum zinc dust content of 94% by mass
- The paint shall be compatible with the galvanizing and shall be inert in concrete

- The brand of material used shall be approved by the galvanizer.

**BASIS OF ACCEPTANCE.** The coating applicator shall furnish a Certificate of Compliance with each shipment of coated bars. The Certificate of compliance shall state the representative samples of the coated bars have been tested and that the test results conform to the requirements described herein. Test results shall be retained and made available, if requested. The Certificate of Compliance and the documentation required for uncoated reinforcement bars by 709-01 Bar Reinforcement, Grade 60 or §709-14, Bar Reinforcement, Grade 75, shall accompany each shipment to the job site.

## **709-12 FOR SITE MANAGER USE**

### **709-13 STAINLESS STEEL BAR REINFORCEMENT**

**SCOPE.** This specification covers the material requirements for stainless steel reinforcing bars used in portland cement concrete.

#### **MATERIAL REQUIREMENTS**

**Material Properties.** The stainless steel shall meet the requirements of ASTM A955 and its designated grade, either 60 or 75. Alloys of stainless steel which meet all the testing and process requirements of ASTM A955 but are not listed in ASTM A955 Table 2 are acceptable if they meet the chemical requirements of ASTM A276, are either austenitic or austenitic-ferritic, and have a UNS designation beginning with either ‘S2’ or ‘S3’.

- A) Deformed Bar Reinforcement - Steel reinforcement shall be deformed billet stainless steel bars or deformed billet stainless steel coils meeting the requirements of ASTM A955 and its designated grade, either 60 or 75.
- B) Plain Rounds - Reinforcement when specified for dowels, structural ties, and supports shall be plain billet stainless steel bars or coils meeting the requirements of ASTM A955 and its designated grade, either 60 or 75.
- C) Spirals – Spirals shall be plain or deformed stainless steel bars in coils or cut lengths meeting the requirements ASTM A955 and its designated grade, either 60 or 75.

**BASIS OF ACCEPTANCE.** Stainless steel bar reinforcement will be accepted on the basis of the manufacturer’s name and location and the fabricator’s name and location (where required) appearing on the Department’s Approved List and a material certification that states the product conforms to this specification or, at the discretion of the Department, based on sampling and testing in accordance with the procedural directives of the Materials Bureau. *Buy America requirements apply.*

### **709-14 BAR REINFORCEMENT, GRADE 75**

**SCOPE.** This specification covers the material requirements for deformed billet steel reinforcing bars used in portland cement concrete. Plain and deformed steel for the fabrication of spirals is included.

#### **MATERIAL REQUIREMENTS**

**Deformed Bar Reinforcement.** Steel reinforcing bars shall be deformed billet steel bars meeting the requirements of ASTM A615, Grade 75.

**BASIS OF ACCEPTANCE.** Bar Reinforcement and spirals will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

### **709-15 GROUTED REINFORCING BAR SPLICE SLEEVES**

**SCOPE.** This specification covers the material requirements for Grouted Splice Sleeves. The splice sleeve and the grout constitute a system, and both parts of the system will appear together on the Approved List.

#### **MATERIAL REQUIREMENTS**

Grouted splice sleeves may be made of plain steel, stainless steel, or steel with epoxy coating. Grouted splice sleeves made of plain steel shall not be used with epoxy coated reinforcement. Grouted splice sleeves will be tested for the following parameters using California Test 670. The total slip shall be a maximum of:

#3 to #6	0.010 in.
#7 to #9	0.015 in.
#10 to #11	0.020 in.
#14	0.025 in.
#18	0.030 in.

The tensile strength of the splice shall be at least 125% of the yield strength of the reinforcing bar as tested according to ASTM A370.

In addition, the manufacturer shall submit test data as set forth in AASHTO LRFD 5.5.3.4 for grout-filled sleeves. The results shall show that the fatigue resistance of the splice meets the set criteria. The sample preparation, testing methodology, and data analysis shall all be conducted by a certified and independent laboratory using the same methodology as that used in NCHRP 10-35.

The grout shall be as supplied by the manufacturer of the splice sleeve, and shall be the same grout that appears on the Approved List.

**BASIS OF ACCEPTANCE.** Grouted Reinforcing Bar Splice Sleeve systems will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that states the product conforms to this specification or, at the discretion of the Department, based on sampling and testing in accordance with the procedural directives of the Materials Bureau. *Buy America requirements apply.*

### **709-16 FOR SITE MANAGER USE**

### **709-99 FOR SITE MANAGER USE**

## **SECTION 710 - FENCE AND GUIDE RAIL**

(Last Revised May, 2021)

### **710-01 ALUMINUM FENCE FABRIC**

**SCOPE.** This specification covers the requirements for aluminum alloy, chain link fence fabric.

**MATERIAL REQUIREMENTS.** Aluminum chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type III, except as modified herein.



**A. Wire.** The aluminum alloy wire shall be 6061-T94 conforming to the applicable chemical composition limits of ASTM B211.

**B. Mesh Size and Wire Diameter.** The size of the mesh and the wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the plans or proposal.

**SHIPPING.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Aluminum fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **710-02 GALVANIZED STEEL FENCE FABRIC**

**SCOPE.** This specification covers the requirements for galvanized steel chain link fence fabric.

**MATERIALS REQUIREMENTS.** Galvanized steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type I, except as modified herein.

**A. Mesh Size Coated Wire Diameter.** The size of the mesh and the coated wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the plans or proposal.

**B. Zinc-Coating.** The 2 inch mesh shall be galvanized with a Class D coating (2 oz/sf) by the hot-dip process after weaving. When 1 inch mesh is specified, it shall be galvanized with Class D Coating (2 oz/sf) before weaving by the electrolytic process.

**SHIPPING.** Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Galvanized steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

### **710-03 VINYL COATED STEEL FENCE FABRIC**

**SCOPE.** This specification covers the material requirements for Class A-Extruded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric, and Class B-Bonded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric.

**MATERIAL REQUIREMENTS.** Vinyl coated steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type IV, except as modified herein.

**A. Mesh Size.** The size of the mesh shall be 2 inches unless otherwise specified in the contract documents.

**B. Wire Diameter.** The wire diameter shall be as follows unless specified otherwise in the contract documents:

**1. Class A-** Extruded Polyvinyl Chloride (PVC)-Coated Steel shall have a 9-gage (0.148 inch) metallic coated core wire.

2. **Class B-** Bonded Polyvinyl Chloride (PVC)-Coated Steel shall have an 11-gage (0.12 inch) metallic coated core wire.

**C. Vinyl Coating.** The color of the vinyl coating shall be dark green unless shown otherwise in the contract documents. The Engineer shall have the option of approving an alternate color if the specified color is unavailable. An adhesion test is not required for coatings which are extruded or extruded and bonded.

**SHIPPING.** Fabric shall be furnished in a clean condition, free of all foreign material, including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Vinyl-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

#### **710-04 ALUMINUM COATED STEEL FENCE FABRIC**

**SCOPE.** This specification covers the requirements for Aluminum Coated Chain Link Fence Fabric.

**MATERIAL REQUIREMENTS.** Aluminum coated steel fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type II, except as modified herein.

**Mesh Size and Coated Wire Diameter.** The size of the mesh and the coated wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the contract documents.

**SHIPPING.** Fabric shall be furnished in a clean condition free of foreign material including oil, dust, film, etc. except that a methacrylate lacquer may be used to protect it under storage conditions.

**BASIS OF ACCEPTANCE.** Aluminum-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

#### **710-05 COATED STEEL FENCE FABRIC, (95% ZINC 5% ALUMINUM - MISCHMETAL ALLOY)**

**SCOPE.** This specification covers the requirements for coated steel fence fabric (95% zinc 5% aluminum - mischmetal alloy).

**MATERIAL REQUIREMENTS.** Coated steel fence fabric (95% zinc 5% aluminum - mischmetal alloy) shall conform to the dimensional and strength requirements of AASHTO M 181 Chain Link Fence Type I, except as modified herein.

**A. Mesh Size.** The size of the mesh shall be 2 inches unless otherwise specified in the contract documents.

**B. Coated Wire Diameter.** The size of the coated wire diameter shall be 9 gage (0.148 inch) unless otherwise specified in the contract documents.

**C. Coating.** The coating shall meet the requirements of ASTM F1345 Class 2 (1 oz/sf).

**SHIPPING.** Fabric shall be furnished in a clean condition, free of all foreign material including oil, dust, film, etc.

**BASIS OF ACCEPTANCE.** Coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

## **710-06 ROCK SLOPE NET AND WIRE MESH ASSEMBLIES**

(Last Revised January 2019)

**SCOPE.** This specification covers the material requirements for the components for assembling a net or wire mesh used as part of a rock catchment system. The following materials are evaluated in this specification:

- 710.0601 – Rock Slope Net Assembly.
- 710.0602 – Rock Slope Wire Mesh Assembly.
- 710.0603 – Rock Slope Wire Mesh Drape Assembly.

### **MATERIAL REQUIREMENTS.**

**A. Rock Slope Net Assembly.** Provide a fence consisting of a net fabricated from wire rope meeting the requirements of §710-27 *Rock Slope Wire Ropes, Seam Rope for Wire Rope Rock Catchment Fence*. The border rope of the net shall meet the requirements of §710-27 *Rock Slope Wire Ropes, Net Supporting Wire Rope for Wire Rope Rock Catchment Fence*.

The mesh size of the net shall be 8 in. by 8 in. The net shall be diagonally woven.

**B. Rock Slope Wire Mesh.** Provide 11 gauge (1/8 in. diameter), single twisted, coated steel wire mesh, with Class 1 (Zn-5Al) coating conforming to ASTM F1345. The steel wire composing the mesh shall have a minimum tensile strength conforming to ASTM A817.

**C. Rock Slope Wire Mesh Drape.** Provide 11 gauge (1/8 in. diameter), 8 by 10 mesh type having a nominal mesh opening of 3 ¼ in. x 4 ½ in., galvanized steel wire mesh, conforming to ASTM A975, Style 1.

**BASIS OF ACCEPTANCE.** The Rock Slope Net Assembly will be accepted on the basis of a material certification that the product conforms to this specification.

The Rock Slope Wire Mesh will be accepted on the basis of a material certification that the product conforms to this specification.

The Rock Slope Wire Mesh Drape will be accepted on the basis of a material certification that the product conforms to this specification.

## **710-07 THRU 710-09 (VACANT)**

## **710-10 STEEL AND IRON POSTS, RAILS, BRACES, AND FITTINGS FOR CHAIN LINK FENCE**

**SCOPE.** This specification covers the requirements for steel and iron posts, rails, braces and fittings used in erecting chain link fence. The contractor shall have the option of supplying any one of the post sections shown on the Standard Sheets.

**MATERIALS REQUIREMENTS.** The following specifications cover the material requirements for each of the sections, fittings, and tension wires shown in the Post and Rail schedule on the Standard Sheets for Chain Link Fence:

**A. Class A, Schedule 40 Pipe.** Posts, rails and braces shall be standard weight Schedule 40 Pipe, manufactured in accordance with ASTM F1083, except that the protective coating system shall be as specified herein.

**B. Class B, Steel Tubing.** Posts, rails and braces shall be manufactured by one of the following methods with the steel conforming to ASTM A1011 or ASTM A1008 and A1011/A1011M with a minimum yield strength of 50,000 psi:

- Furnace butt welded, continuous welded
- Cold rolled and electric resistance welded
- Seamless

The tubing shall conform to the following dimensions:

Nominal Size (inches)	Outside Diameter, inches	Minimum Wall Thickness, inches	Weight lb/ft
1 1/4	1.660	0.111	1.836
1 1/2	1.900	0.120	2.281
2	2.375	0.130	3.117
2 1/2	2.875	0.160	4.639

**C. Class C, Rolled-Formed Shapes.** Posts, rails and braces shall be roll formed shapes which meet the requirements of ASTM F1043.

**D. H-Posts.** H Posts shall be fabricated from hot-rolled steel sections which meet the requirements of ASTM F1043.

**E. Fittings.** Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy.

**1. Weldable Steel.** Weldable steel shall be commercial quality or better, produced by one of the following processes: Open-Hearth, Electric Furnace, or Basic Oxygen.

**2. Malleable Iron.** Malleable Iron shall conform to the requirements of ' 715-09.

**3. Cast Iron.** Cast iron shall conform to the requirements of ' 715-05.

**4. Cast Steel.** Cast steel shall conform to the requirements of ' 715-02.

**5. Aluminum Alloy.** Aluminum alloy shall meet the material requirements of ' 710-11.

Fittings other than aluminum fittings in contact with galvanized surfaces shall be galvanized in accordance with ' 719-01, Type II. Fittings in contact with aluminum surfaces shall be made of aluminum alloy or be aluminum coated in accordance with ' 719-03.

**F. Tension Wire.** Tension wire shall meet the requirements of ASTM A641M, as modified herein. The wire shall be a no. 7 gage minimum  $0.177 \pm 0.004$  inch in diameter, having a minimum tensile strength of 80,000 psi, with a minimum galvanized coating of 0.7 oz/sf or a minimum aluminum coating of 0.3 oz/sf.

**Protective Coating Systems.** Posts, rails and braces shall be coated with a protective coating system conforming to one of the following depending on structural member.

***A. Class A Schedule 40 Pipe; Class B Steel Tubing***

***1. Galvanized Coatings.*** Galvanized both inside and out in accordance with ASTM F1083.

***2. Combined Coatings***

*a. External surfaces.* The external surfaces shall be coated with the following combined coating system:

*(1) Hot Dip Galvanizing.* The external surface shall be hot-dip galvanized with “Special High Grade” or “High Grade” slab zinc conforming to ASTM B6. The weight of the coating shall be a minimum 0.9 oz/sf.

*(2) Chromate Conversion Coating.* Chromate conversion coating shall be specifically designed for use as a pretreatment of galvanized surfaces. The coating shall be applied prior to the application of the thermoplastic acrylic coating at the manufacturer's recommended rate.

*(3) Clear Coating.* A thermoplastic acrylic or cross linked polyester coating shall be applied with a minimum dry film thickness of 0.3 mils.

*b. Internal Surfaces.* The internal surfaces of the pipe or tubing shall be coated with one of the following:

*(1) Zinc rich coating.* The zinc rich coating shall contain not less than 87% zinc dust by weight and shall be capable of providing galvanic protection. The minimum coating thickness shall be 0.3 mils.

*(2) Cross linked polyester coating containing a corrosion inhibitor*

*(3) Hot-dip galvanized coating.* The hot-dipped galvanized coating shall average not less than 0.35 oz/sf and no single specimen shall show less than 0.25 oz/sf.

***B. Class C Roll Formed Shapes and H Posts.*** All surfaces shall be hot-dip galvanized in accordance with the requirements of '719-01, Type I.

***C. Class A Schedule 40 Pipe; Class B Steel Tubing; Class C Roll Formed Shapes, H-Posts.***

***1. Aluminum with Chromate Coatings.*** All surfaces shall be given a hot-dipped 99% pure aluminum, Type II coating. The aluminum coating shall average 0.66 oz/sf and no single specimen shall show less than 0.61 oz/sf when tested in accordance with ASTM A428. The coating shall meet the adherence and quality requirements of '719-03. The aluminum coated surfaces shall be given a colorless chromate chemical treatment. The external surfaces shall be given a colorless protective resin coating to protect the material from abrasion in shipment and storage.

**2. Mischmetal Alloy Coating (95% Zinc 5% Aluminum).** Coating shall meet the requirements of ASTM F1043 Protective Coatings on Steel Framework for Fences Type C, except the coating weight shall be 1.0 oz/sf.

**BASIS OF ACCEPTANCE.** Steel and iron posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

**710-11 ALUMINUM POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE**

**SCOPE.** This specification covers the requirements for aluminum posts, rails, braces and fittings to be used in erecting chain link fencing.

**MATERIAL REQUIREMENTS.** Posts, Rails, Braces and Fittings shall conform to the following materials specifications, alloy, temper and dimensional requirements in Table below.

**BASIS OF ACCEPTANCE.** Aluminum posts, rails, braces and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification.

Material	Material Spec.	Alloy & Temper	Dimensions
Fabric Ties	715-04	5052-H-38, 1100-H18 or 3003-H14	0.144 in. nom.dia.or 1/2 in. wide x 0.06 in. thick
Top & Bottom Tension Wires	715-04	6061-T94	0.192 in. nom. dia.
Hog Rings	715-04	6061-T94	0.110 in. nom. dia.
Stretcher Bars	715-04	6063-T5 or 6063-T6	1/4 x 3/4 in.
Truss Rods	715-04	6061-T6 or 6063-T6	3/8 in. nom. dia.
Cast Tumblers	715-03	356.0-T6	-
Wrought Turnbuckles	715-04	6061-T6 or 6063-T6	-
Brace & Stretcher Bands	715-04	3003-H14 or 6063-T6	1/8 x 7/8 in.
Carriage Bolts	715-04	2024-T4	-
Brace Ends & Rail Ends	715-03	356.0-T6, 360.0, D712.0, or ZG 61A-T5	-
Expansion Sleeves	715-04	6063-T6 or 6063-T832	See Note 1
Nuts	715-04	2024-T4 or 6061-T6	-
Line Posts	715-04	6063-T6	Sched. 40 pipe 2 in. diam.
End, Corner & Intermediate Posts	715-04	6063-T6	Sched. 40 pipe 2 1/2 in. diam.
Post Tops	715-03	356.0-F, 360.0, D712.0, or ZG61A-T5	-
Top Rails	715-04	6063-T6	Sched. 40 pipe 1/4 in. diam.
Brace Rails	715-04	6063-T6	Sched. 40 pipe 1/4 in. diam.

**NOTE:** 1. Modified Schedule 40 pipe, 1 1/2 in. nom. diam., 1.69 in. Inside Diameter, 0.078 in. Minimum Wall Thickness, 6 in. long.

**710-12 PLASTIC COATED POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE**

**SCOPE.** This specification covers the requirements for plastic coated posts, rails, braces and fittings used for erection of chain link fencing.

**MATERIAL REQUIREMENTS.** Posts, rails, braces, fittings, and accessories shall comply with the requirements of '710-10, except for the galvanized coatings. Post, rails, braces, fittings and accessories shall be resin-clad with either an epoxy modified ply (vinyl chloride), or a thermoplastic polyester resin. The coating shall have a minimum thickness of 7 mils and shall be of the same color as the fabric.

**Fabrication Requirements.** The epoxy modified poly (vinyl chloride) coating shall be chemically bonded to heated pipe, fittings, etc., or the fitting and pipe, etc., shall be clad with a heavy molecule, saturated, linear thermoplastic polyester resin applied by electrostatic spray and fusing or equal method. Each length of pipe shall be sealed with two snug-fitting polyethylene plug-type seals to prevent condensation and eliminate internal corrosion.

**BASIS OF ACCEPTANCE.** Plastic-coated posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

### **710-13 WOOD AND TIMBER POSTS AND TIMBER BLOCKOUTS**

**SCOPE.** This specification covers wood posts used as witness posts, timber posts, and blockouts used in guiderail construction.

**MATERIALS REQUIREMENTS.** Wood posts, timber posts, and timber blockouts shall comply with the requirements of '712-14, Stress Graded Timber and Lumber, except that not every timber blockout in the lot need be branded, provided that approximately 10% of the blockouts are branded, and that the unbranded blockouts are visually similar, as determined by the engineer, to the branded blockouts. Using the clean wood properties of ASTM D2555, the bending stress (Modulus of Rupture) shall not be less than 4000 psi. They shall be surfaced on four sides and the dimensions shall be actual or nominal as indicated on the plans. If the dimensions are indicated to be nominal, the actual dimensions provided shall be in accordance with current trade practice. Surface dried redwood, red cedar, cypress or black locust may be used untreated. Other lumber including douglas fir, pine, oak, birch, apple, and beech may also be used but shall be pressure treated in accordance with '708-31, Wood Preservative-Water Borne after all the holes have been drilled and all other woodworking operations have been performed.

Bituminous preservative treatments will not be permitted. Before using, the Contractor shall submit to the Engineer, for approval, information as to the species of timber to be used and method of preservative treatment to be employed.

**BASIS OF ACCEPTANCE.** Wood and timber posts and timber blockouts will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **710-14 GALVANIZED STEEL BARRIER POSTS**

**SCOPE.** This specification covers galvanized steel posts used as guiderail and median barrier posts, I-beam posts for existing guide railing and median barrier, and required soil plates, Anchor Post Base, and slip impact bases.

**MATERIAL REQUIREMENTS.** Galvanized steel barrier post shall conform to the following:

Galvanizing Steel	719-01 Galvanized Coatings and Repair Methods, Type I ASTM A36
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**Posts.** Steel posts used as guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier, shall be fabricated from steel conforming to the ASTM A36 shape specified on the standard sheet for the guide railing or median barrier being utilized.

**Soil Plates, Slip Impact Bases, and Other Post Components.** Soil plates, slip impact bases, and other post components shall be fabricated from steel conforming to the dimensions shown on the standard sheet for the guide railing or median barrier being utilized.

**FABRICATION.** Guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier shall be fabricated with all required welding, punching, drilling, or cutting of the post or any component of the post completed prior to galvanizing. Welding shall be done in accordance with the requirements of the *New York State Steel Construction Manual*, except that radiographic inspection of shop welds will not be required.

**BASIS OF ACCEPTANCE.** Galvanized steel barrier posts will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*”

#### **710-15 AND 710-16 (VACANT)**

#### **710-17 CORRUGATED BEAM GUIDE RAILING END TERMINAL (ENERGY-ABSORBING)**

**SCOPE.** This specification covers the material and performance requirements for energy-absorbing corrugated beam end terminals.

**MATERIALS REQUIREMENTS.** All metal components and hardware shall be new and galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

**BASIS OF APPROVAL.** End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2.

Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Corrugated Beam End Terminals (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer’s name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer’s certification that the product delivered is in conformance with these specifications.

#### **710-18 HPBO (Mod.) CORRUGATED BEAM GUIDE RAILING END TERMINAL (ENERGY ABSORBING)**

**SCOPE.** This specification covers the material and performance requirements for HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing).

**MATERIALS REQUIREMENTS.** All metal components and hardware shall be new and galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.



**BASIS OF APPROVAL.** End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2.

Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Corrugated Beam End Terminals (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

### **710-19 HPBO (Mod.) CORRUGATED BEAM MEDIAN BARRIER END TERMINAL (ENERGY ABSORBING)**

**SCOPE.** This specification covers the material and performance requirements for HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing).

**MATERIALS REQUIREMENTS.** All metal components and hardware shall be new and be galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

**BASIS OF APPROVAL.** End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2.

Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

### **710-20 CORRUGATED BEAM GUIDE RAILING AND MEDIAN BARRIER**

**SCOPE.** This specification covers corrugated beam guide railing and median barrier including corrugated beams, posts, anchorage units and accessory hardware.

#### **MATERIAL AND FABRICATION REQUIREMENTS**

**General:** For new installations all components shall be new.

**Posts.** Posts shall meet the requirements of 710-14 Galvanized Steel Barrier Posts

**Beams, Terminal Sections and Hardware.** Corrugated beams, terminal sections and all hardware shall be fabricated in accordance with the details shown on the standard sheets. Bolt holes in the beam at the post hole and elsewhere, as necessary, shall be enlarged or slotted to permit expansion and contraction, and to facilitate erection. The beams shall be of uniform section and straight, unless shop curved beams are required by the plans or specifications. The edges shall be rolled to eliminate sharp edges. When shop

curving of corrugated beams is required the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be on the back, at or near both ends of the beam, and in a location where it will be visible to a worker after erection.

Beams and terminal sections shall be rolled from 12 gage (nominal thickness 0.105 inches -0.009 inch tolerance) or heavier sheet or coil stock. The sheet or coil stock shall be new billet open hearth, electric furnace, or basic oxygen steel sheet. The minimum yield point and elongation of the steel used in the beam sections shall be 50,000 psi and 12% in 2 inch gage length respectively. Terminal sections, used for finishing-off or ornamental purposes, may be of mild steel, 33,000 psi yield point.

**Plates and Anchorage Units.** Plates and Anchorage Units shall be as detailed on the standard sheet for corrugated beam type guide railing and median barrier. They shall conform to ASTM A36.

**Splices and Post Bolts.** Splices and post bolts shall be made with flat, roundheaded, grippable, galvanized bolts, nuts, and washers conforming to the following, unless specified otherwise in the contract documents: Bolts ASTM A307 Grade A, Nuts ASTM A563 Grade A or better, and Washers ASTM F844. They shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type II (ASTM A153) unless another coating is specified.

Post bolts and the splice bolts shall be as detailed on the Standard Sheets.

**Fabrication Welding.** Fabrication welding shall be done in accordance with the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

**Galvanizing.** The rail element shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123) or Type IV (ASTM A653/653M) of the standard specifications, except that the minimum check limits for the weight of coating as determined by the triple spot and single spot tests for 719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A653/653M), shall be 4 oz/ft<sup>2</sup> and 3 oz/ft<sup>2</sup> respectively, (total amount both sides of sheet). Posts, plates, and anchorage units shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123). Hardware shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type II (ASTM A153).

When beams are to be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123), they shall be blanked to the proper shape, fabricated and ready for assembly before galvanizing. No punching, drilling, cutting or welding will be permitted after galvanizing. When galvanizing in accordance with 719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A653/653M), the beam may be fabricated, cut, punched or drilled from galvanized sheet or coil stock. The exposed edges resulting from this process do not have to be repaired or touched up in any way.

**BASIS OF ACCEPTANCE.** All components of the corrugated beam type guide railing and median barrier shall be accepted in accordance with directives issued by the Department.

## **710-21 BOX BEAM GUIDE RAILING AND MEDIAN BARRIER**

**SCOPE.** This specification covers box beam guide railing and median barrier including the guide rail, posts, end assembly units and accessory hardware.

### **MATERIAL REQUIREMENTS**

**General:** For new installations all components shall be new.

**Posts.** Posts shall meet the requirements of 710-14 Galvanized Steel Barrier Posts.

**Rails.** Rails shall be cold-formed welded and seamless structural tubing. The rails shall conform to ASTM A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B, except as modified below. Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-Notch tested. Splice tubes need not be tested.

All rail shall be tested in accordance with ASTM E436 “Drop-Weight Tear Tests of Ferritic Steels” except as modified below.

The tests shall be done after all galvanizing and associated operations have been performed on the rail. The testing shall be conducted at a temperature of -0.4°F, without removing the galvanizing, on 2 x 9 inch specimens supported to achieve a 7 inch span.

The percent shear area will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50, the material represented by these tests shall be rejected.

To facilitate acceptance and rejection of material the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 4 feet.

When shop curving of box beams is required, the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be the vertical faces, at or near both ends of the beam, and in a location where it will be visible to a worker after erection.

No mill transverse welds will be permitted on the rail sections. Longitudinal welds shall be made by the resistance, gas shielded arc, submerged arc or plasma arc welded process; shall be sound, free from defects, and shall not be repaired. The welded joint, in cold-formed welded rail, shall have a minimum tensile strength specified for the railing when tested according to the tensile strap test of ASTM Method E8. All fabrication shall be done in accordance with the requirements of the Steel Construction Manual.

Rails shall be galvanized in accordance with 719-01, Type I, Galvanized Coatings and Repair Methods. Slots and round holes may be subsequently drilled, punched, burned, or cut and regalvanized according to the paragraph below on “Regalvanizing Iron and Steel Using a Flame Sprayed Coating System.” This repair procedure shall also apply to curved rail sections and splice plates as required.

**Regalvanizing Iron and Steel Using a Flame Sprayed Coating System.** Those areas to be regalvanizing shall be blasted with silica sand or crushed garnet of such gradation that sand shall be mesh size # 20 to # 40 U.S. Standard Sieve with a minimum of 40% retained on a # 30 U.S. Standard Sieve. Pressure of not less than 75 psi shall be maintained at the blast generator.

A sample steel plate shall be blasted until the surface cannot be further cleaned or roughened. This plate shall be used for visual comparison and any areas that do not meet this standard as to roughness or cleanliness shall be reblasted.

The wire used in spraying shall be 1/8 or 3/16 inch diameter, zinc 99.0% purity. Air pressure at the Air Control Unit shall be 60 psi and there shall be no more than 35 feet of 3/8 inch I.D. hose between the Air Control Unit and the gun.

The metal coating shall be applied at a minimum thickness of 0.0045 inches. At least one coating shall be applied within 4 hours of blasting and the surface shall be completely coated within 8 hours of blasting.

The specified thickness of coating shall be applied in multiple layers and in no case shall less than two passes be made over every part of the surface.

**Fasteners.** Fasteners shall be galvanized and conform to the following unless specified otherwise in the contract documents. Bolts ASTM A307 Grade A, nuts ASTM A563 Grade A or better, and washers ASTM F844.

**FABRICATION.** Curved box beam guide rail or median barrier shall be shop bent or shop mitered in accordance with the following. At the fabricator's option, the shop mitering process may be used instead of a shop bending process. However, shop bending may not be used in place of shop mitering.

**1. Shop Bent Box Beam Guide Railing.** Box beam guide rail installed on a curved alignment with a radius above 20 and up to 720 feet shall be shop bent prior to galvanizing. In order to achieve a smooth arc, the bend points shall be placed no farther apart than two feet when the radius is from 20 to 50 feet, no farther apart than three feet when the radius is between 50 and 150 feet, and no farther apart than four feet when the radius is 150 feet or greater.

**2. Shop Mitered Box Beam Guide Railing.** Box beam guide railing installed on a curved alignment with a radius of 20 feet or less shall be miter cut and welded in the shop prior to galvanizing. For radii less than 12 feet, the average spacing of the cuts shall be approximately 18 inches. For radii from 12 feet to 20 feet, the average spacing of the cuts shall not exceed 24 inches. Cut locations shall be adjusted as needed to avoid bolt holes and post brackets. After the miter cuts are completed, backer bars shall be tack welded to one side of the cut and the miter shall be closed to within a quarter of an inch (+ 0", -1/8") and butt welding performed in accordance with AWS D1.1. Section 3.

**3. Shop Bent Median Box Beam Barrier.** Box beam median barrier installed on a curved alignment with a radius above 30 and up to 1525 feet shall be shop bent prior to galvanizing. For radii between 30 and 60 feet, the bending shall be performed prior to cutting the slots for the post support paddles. In order to achieve a smooth arc, the bend points shall be placed no farther apart than 18 inches.

**4. Shop Mitered Box Beam Median Barrier.** Box beam median barrier installed on a curved alignment with a radius of 30 feet or less shall be miter cut and welded in the shop prior to galvanizing. For radii less than 12 feet, the average spacing of the cuts shall be approximately 18 inches. For radii of 12 feet or greater, the average spacing of the cuts shall not exceed 24 inches. Cut locations shall be adjusted as needed to avoid post support slots. After the miter cuts are completed, backer bars shall be tack welded to one side of the cut and the miter shall be closed to within a quarter of an inch (+ 0", -1/8") and butt welding performed in accordance with AWS D1.1. Section 3.

**BASIS OF ACCEPTANCE.** All components of the box beam guide railing and median barrier shall be accepted in accordance with directives issued by the Department.

## **710-22 CABLE GUIDE RAILING**

(Last Revised September, 2020)

**SCOPE.** This specification covers cable guide railing including cable, posts, anchorage units, and accessory hardware.

**DEFINITIONS.** There are two kinds of cable guide rails depending on the amount of tension in the cables -

- A. Medium-Tension Cable Guide Rail – When the tension in each of the cables in a cable system is less than 2500 pounds at 72° F.
- B. High-Tension Cable Guide Rail – When the tension in each of the cables in a cable system is 2500 pounds or more at 72° F.

## **MATERIAL REQUIREMENTS.**

**General.** For new installations, all components shall be new.

Cable Guide Railing systems that are listed on the Approved List and are proprietary in nature shall conform to the manufacturer's requirements as indicated in the NYSDOT-approved Materials Details.

Cable Guide Railing meeting the Standard Sheets shall conform to the following:

Posts, Soil Plates	710-14 Galvanized Steel Barrier Posts
Reflectors	730-01 Aluminum Sign Panels
Reflective Sheeting	730-05 Reflective Sheeting
Cable Construction	AASHTO M30 or ASTM A741 Type I Class A
Coating	
Anchor Angle, Anchor Post Base	ASTM A36
Bolts	ASTM A307 Grade A
Nuts	ASTM A563 Grade A
Washers	ASTM F844
Concrete	Class A

**Cable End Assemblies.** Designs for a steel turnbuckle cable-end assembly or spring cable-end assembly not shown on the standard sheet or detailed in the plans shall be submitted for approval.

**Hook Bolts.** Hook bolts shall develop an ultimate pull open strength of from 450 lbs to 1000 lbs applied in a direction normal to the longitudinal axis of the post.

**Galvanizing.** The bolts, including the "J" bolt used to mount the cable, nuts, washers, anchor rods, spring compensator components, steel turnbuckle cable end assembly, and all cast steel or malleable iron hardware, except the wedge shown on the Standard Sheet, shall be galvanized in accordance with the requirements of 719-01 Galvanized Coatings and Repair Methods, Type II, unless another coating is specified. The wedge shown on the Standard Sheet shall be ungalvanized (black).

The anchor angles, and Anchor Post Base shall be galvanized in accordance with the requirements of 719-01 Galvanized Coatings and Repair Methods, Type I.

**Welding.** Welding shall be performed in accordance with the requirements of the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

**BASIS OF APPROVAL.** Cable Guide Railing designs other than those shown on the Standard Sheets may be proposed, and if found acceptable, will be placed on the approved list. Evidence shall be provided that the Cable Guide Railing is MASH-16 approved. Systems that have passed MASH-09 only may be accepted on a limited time basis. If approved and as a requirement to be placed on the Approved List, Materials Details of the approved system shall be supplied by the manufacturer to be posted on NYSDOT web site.

**BASIS OF ACCEPTANCE.** Cable Guide Railing supplied will be accepted based on the following requirements:

1. System supplied meeting the Standard Sheets or
2. The manufacturer's name appearing on the Approved List and the manufacturer's certification that the system supplied meets the specifications and the manufacturer's Materials Details posted with the Department's Approved List.

## 710-23 STEEL BRIDGE RAILING

**SCOPE.** This specification covers the material requirements for Steel Bridge Railing and its component parts.

**MATERIAL REQUIREMENTS.** Steel Bridge Railing materials shall conform to the following requirements:

Piece	ASTM Designation
Rail Tubes	A500 Grade B
Rail End Caps	A36 (A709 Grade 36)
Base Plates <sup>1</sup>	A572 Grade 50 (A709 grade 50)
Anchor Studs	F3125 GRADE A325 or A449 Grade 1
Splice Bolts	F3125 GRADE A325 or A449 Grade 1
Round Head Bolts	F3125 GRADE A325 or A449 Grade 1
Nuts <sup>2</sup>	A563
Washers <sup>2</sup>	F436
Lock Washers	High Carbon Heat Treated Spring Steel: ASME B18.2
Anchor Plates	A36 (A709 Grade 36)
Plate Shims	A36 (A709 Grade 36)
Tube Rail Splices	A500 Grade B
Solid Rail Splices	A572 Grade 50 (A709 grade 50)
Angle <sup>1</sup>	A572 Grade 50 (A709 grade 50)
Splice Plates	A572 Grade 50 (A709 grade 50)
Railing Post <sup>1</sup>	A572 Grade 50 (A709 grade 50)
Tubular Posts	A500 Grade B

1 All post material, including base plates, shall be furnished to minimum Charpy V-notch toughness requirements as required by §715-01, under Charpy V-Notch Impact test.

2 Use the following nut and washers for the given bolt class:

Bolt or Stud	NUT A563 (class & Dimension style of nut)	Washer A563 Type
4.6	5 H1	1 or 3
8.8	10S HH	1 or 3

Beveled shims may be machined from the same type of metal as in the post base plates or may be cast from material conforming to the requirements of 715-02, Steel Castings, or 715-09, Malleable Iron Castings.

All rail, except bicycle and pedestrian rail, shall be tested in accordance with ASTM E436 - "Drop-Weight Tear Tests of Ferritic Steels", except as modified below.

The tests shall be done after all galvanizing and associated operations have been performed on the rail. The testing shall be conducted at a temperature of 0°F, without removing the galvanizing, on 2 x 9 inch specimens supported to achieve a 7 inch span.

The percent shear will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50 the material represented by these tests shall be rejected.

Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-notch tested. Splice tubes need not be Charpy V-notch tested.

To facilitate acceptance and rejection of material, the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 4 feet.

**FABRICATION.** Bridge Railing shall be fabricated to the dimensions shown in the contract plans and in compliance with the specifications.

**A. Shop Drawings.** Shop drawings, when required by the contract documents, shall be provided in accordance with the requirements of the S.C.M., except that: 1) the drawings shall be submitted to the Engineer for review and approval and 2) the computed weights need not be shown.

**B. Welding.** Shop welding shall be performed only where specifically noted on the contract documents. Transverse welds shall not be permitted unless directly called for on the contract plans. All welding shall be done in accordance with the requirements of the SCM.

**C. Cutting.** All exposed flame cut surfaces shall have a surface roughness not to exceed 250, as defined by the ANSI standard specification B46.1. Grind all edges of Posts and Post Base Plates so that all sharp edges are removed.

**D. Bending.** Rails for curved structures shall be curved in the shop prior to galvanizing. To facilitate bending, rails may be heated to a temperature not exceeding 1200°F.

**E. Galvanizing.** Galvanizing shall conform to the requirements of 719-01, Galvanized Coatings and Repair Methods, Type I. All components of the railing, including anchor studs, nuts and washers, shall be galvanized. The rails, post assemblies, splices and all hardware shall be fabricated and ready or assembly prior to galvanizing.

All galvanized bolts and galvanized anchor studs shall have a Class 2A Thread. All galvanized nuts shall have a standard oversized tap to allow for the galvanizing on the bolts and nuts. Shop galvanizing repair of uncoated areas will be permitted on localized areas. Repair of localized areas is limited to a total of 2 square inches on any post or rail. A post or rail which contains galvanizing defects totaling more than 2 square inches shall be stripped and regalvanized.

Shop repair shall be made in accordance with the methods given in 719-01.

The following areas will not require galvanizing repair: One 1/8 inch maximum dimension spot of tight flux remaining in the fusion line of any 7 inch length of weld after blast cleaning picking and galvanizing.

**F. Brown Rail.** When brown rail is specified, all components of the railing system shall be galvanized and then the visible portions of the system shall be painted in accordance with §657 Painting Galvanized and Aluminum Surfaces. Paint color shall be 'Weathered Brown' as defined by 708-05 Standard Paint Colors.

**BASIS OF ACCEPTANCE.** The manufacturer shall furnish the Department with three (3) certified copies of physical test and chemical analysis of the materials used in the manufacture of the railing. Check analysis may be made by the Department from delivered material.

Inspection will be performed in accordance with the provisions of the SCM, except that mill inspection will not be done.

Materials that do not bear the Inspector's mark of acceptance shall not be accepted at the project site.

## **710-24 BOX BEAM GUIDE RAIL END ASSEMBLY, TYPE III; AND BOX BEAM MEDIAN BARRIER END ASSEMBLY, TYPE C**

**SCOPE.** This specification covers the material and performance requirements for Box Beam End Assembly Type III and for Box Beam Median Barrier End Assembly, Type C.

**MATERIALS REQUIREMENTS.** All metal components and hardware shall be new and be galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

**BASIS OF APPROVAL.** End Terminal systems shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2.

Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, complete crash test videos, installation manuals, and Federal Acceptance Letters to the Director of the Design Quality Assurance Bureau. Upon approval, the name of the manufacturer, the product, and the drawings and installation manual will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** After May 1, 2021, including on active construction contracts, all Box Beam Guide Rail End Assembly, Type III; and Box Beam Median Barrier End Assembly, Type C will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with those Materials Details."

## **710-25 (VACANT)**

## **710-26 PLASTIC AND SYNTHETIC BLOCK-OUTS FOR HEAVY POST GUIDERAIL SYSTEMS**

**SCOPE.** This specification describes plastic and synthetic material block-outs used to provide uniform offset distance from the corrugated beam rail to the heavy post.

**GENERAL.** The block-out shall have the same general dimensions as detailed in the Department Standard Sheets. The block-out shall not contain excessive voids that would compromise its physical strength. The material shall be designed for outdoor exposure and shall include chemical additives to resist UV degradation. If the product contains recycled materials, they shall be environmentally friendly and non-hazardous. Blocks shall contain no materials that will negatively affect their field performance, such as materials that absorb moisture.

**BASIS OF ACCEPTANCE.** Manufacturers or suppliers may submit their product for evaluation to the Director of the Materials Bureau. This submission shall include copies of drawings, specifications, test reports, the quality control procedure and Federal Acceptance Letters. At the Department's discretion, the material will be evaluated for conformance to these specifications, and product samples will be tested in accordance with procedural directives of the Materials Bureau.

The product will be accepted at the job site based on its appearance on the Approved List. In addition, the contractor shall provide manufacturer certification that the supplied product has the same chemical composition, mechanical properties as the product used in the testing accepted for Federal Approval. Modifications to this product are acceptable, provided the resulting product is an equivalent or of higher level of quality, and supporting documentation is provided.



## 710-27 ROCK SLOPE WIRE ROPES

**SCOPE.** This specification covers the material requirements for the components for wire ropes generally used in a rock catchment system. The following materials are evaluated in this specification:

- 710.2701 – Rock Slope Wire Ropes, Net Supporting Wire Rope for Wire Rope Rock Catchment Fence.
- 710.2702 – Rock Slope Wire Ropes, Seam Rope for Wire Rope Rock Catchment Fence.
- 710.2703 – Rock Slope Wire Ropes, Tieback Restraining Cable for Wire Rope Rock Catchment Fence.
- 710.2704 – Rock Slope Wire Ropes, Anchor Cable for Wire Rope Rock Catchment Fence.
- 710.2705 – Rock Slope Wire Ropes, Seam Rope for Wire Mesh Slope Protection

**MATERIAL REQUIREMENTS.** Provide material in accordance with TABLE 710-27A *Rock Slope Wire Ropes*.

<b>TABLE 710-27A ROCK SLOPE WIRE ROPES</b>			
<b>Rock Slope Wire Rope</b>	<b>Rope/Cable</b>	<b>Minimum Diameter</b>	<b>Minimum Breaking Strength</b>
Wire Ropes for Wire Rope Rock Catchment Fence	Net Supporting Wire Rope	5/8 in. (6x19 construction)	37 kips
	Seam Rope	5/16 in. (7x7 construction)	9 kips
	Tieback Restraining Cables	5/8 in. (6x19 construction)	37 kips
	Anchor Cables (10 ft. min. length, equipped with heavy duty type thimbles)	3/4 in.	53 kips
Seam Wire for Wire Mesh Slope Protection	Seam Rope	5/16 in. (7 x 19 Galvanized Aircraft Cable)	10 kips

All wire ropes for the wire nets, supporting ropes, seam ropes and anchors shall be composed of steel wires individually galvanized before being woven into the ropes.

**BASIS OF ACCEPTANCE.** The Wire Ropes for Wire Rope Rock Catchment Fence will be accepted on the basis of a material certification that the product conforms to this specification.

The Seam Wire Rope for Wire Mesh Slope Protection will be accepted on the basis of a material certification that the product conforms to this specification.

## 710-28 ANCHOR BOLTS FOR GUIDE RAILING AND MEDIAN BARRIER

**SCOPE.** This specification covers the material requirements for anchor bolts.

**MATERIALS REQUIREMENTS.** Anchor bolts shall meet the requirements of ASTM A449. A hex nut and flat washer shall be supplied with each anchor bolt and their dimensions shall be as shown on the plans or Standard Sheets. The hex nut and flat washer shall be manufactured in accordance with ASTM F3125 GRADE A325. The nuts, washers, and the top 12 inches of the anchor bolts shall be galvanized in accordance with the requirements for Type II or Type V galvanizing as stated in section §719-01, Galvanized Coatings and Repair Methods. The anchor bolt, nut and washer dimensions shall be as shown on the plans or Standard Sheets.

**SHIPPING.** Anchor bolts, hex nuts, and washers shall be shipped to the construction site at a time convenient to the masonry construction.

**BASIS OF ACCEPTANCE.** Anchor bolts will be accepted upon the manufacturer's certification that they meet the requirements of this section.

**710-29 (VACANT)**

**710-30 RIGHT-OF-WAY FENCING**

**SCOPE.** These specifications cover the material requirements required for the construction of right-of-way fences comprised of (a) galvanized steel or aluminum coated steel fence fabric, and (b) posts, braces and hardware designed to support and retain the fencing.

**MATERIAL REQUIREMENTS**

**Fence Fabric.** Right-of-way fencing fabric shall conform to the requirements of ASTM A116 “Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric”. The fabric shall be woven in accordance with Design Number 1047-6-9 or 1047-6-11 as shown in Table 1 of both ASTM A116. The weight of the coating on the Zinc-Coated (Galvanized) Fence Fabric shall conform to the coating weight requirements of Class 3 shown in Table 2 of ASTM A116.

**Fence Posts and Braces.** Posts and brace sizes shall be as indicated on the Standard Sheets. Steel line posts shall conform to the requirements of ASTM A702. Steel end, corner or intermediate post and braces shall conform to the requirements of Section 6.5 through Section 6.5.4 of ASTM A702; or the requirements for Class A, Schedule 40 Pipe or Class B, Steel Tubing of 710-10.03 of the Standard Specifications. Posts and braces conforming to the requirements of ASTM A702 shall be galvanized in accordance with the requirements of 719-01 Type I. Type A Schedule 40 Pipe and Type B Steel Tubing shall use one of the protective coating system specified in 7A of ' 710-10.03.

Wood posts and braces shall be seasoned southern yellow pine, red (Norway) pine, spruce, douglas fir, hemlock, larch, or redwood. All wood posts and braces shall be pressure treated with a water-borne wood preservative conforming to the requirements of ' 708-31. The wood posts shall be subject to inspection before and during treatment at the option of the Department. They shall be sound, free from loose knots or decay, and with no through checks on tops or butts. Posts shall be machine peeled to a smooth uniform appearance and free from all inner bark. The preservative pressure treatment shall be by the empty cell process in accordance with C5 of the American Wood-Preservers' Association Standards.

**Fittings.** Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy. Fittings other than aluminum shall be galvanized in accordance with the requirements of 719-01 Type II.

**Fasteners.** Bolts, nuts, and washers shall conform to the following, unless specified otherwise in the contract documents:

Bolts	ASTM A307
Nuts	ASTM A563 Grade A or better
Washers	ASTM F844

The fasteners shall be galvanized in accordance with the requirements of 719-01 Type II.

**Gates.** Gates shall be constructed of Class A Schedule 40 Pipe conforming to 710-10 welded at all corners or assembled with corner fittings. The size of the pipe used to fabricate the gate shall be as shown on the Standard Sheets. When corner fittings are used the gates shall have truss rods of minimum 3/8 inch diameter to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 8 feet apart. Gate leaves over 10 feet shall have a truss rod of 3/8 inch minimum diameter even if the corners are welded. The fence fabric used on the gate shall conform to the fence fabric in the remainder of the fence.

**A. Hinges.** Hinges shall be weldable steel, cast steel, or malleable iron 180<sup>o</sup> offset industrial type. The hinges shall not twist or turn under the action of the gate. The gate shall be able to be opened by one person. The hinges shall be galvanized in accordance with the requirements of 719-01 Type I.

**B. Latches.** Latches, stops, and keepers shall be provided for all gates.

Latches for single leaf gates may be a forked latch type. Double leaf gates shall have a plunger bar type latch arranged to engage a stop. Latches shall be capable of being locked and the Contractor shall provide a lock with triplicate keys for each gate. Keepers shall consist of a mechanical device for securing the free end of a gate when in the full open position.

**C. Gate Posts.** Gate posts shall conform to the dimensions shown on the Standard Sheets.

Steel gate posts shall be fabricated from either Class A Schedule 40 Pipe or Class B Steel Tubing conforming to the requirements of 710-10.

Wood gate posts shall be made from wood conforming to the requirements for wood posts and braces as specified in "Fence Posts and Braces".

**BASIS OF ACCEPTANCE.** Right-of-way fencing will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

## **710-35 SECURITY BOLLARDS**

**(New Section September, 2019)**

**SCOPE.** This specification covers the material requirements and testing methods for Security Bollards.

**GENERAL.** The security bollards are described as follows:

- 1. Single Bollard.** A single bollard shipped and installed as a single unit.
- 2. Bollard Array.** A group of two or more bollards pre-assembled to a metal "sled". The assembly may or may not include reinforcing bar. The components are welded together to form a unit.
- 3. Retractable Bollard.** A bollard that may be briefly lowered to permit the passage of one or more vehicles.
- 4. Removable Bollard.** A bollard that may be readily removed from its foundation, typically for seasonal maintenance needs. Such bollards are usually locked in place and may only be unlocked by authorized personnel.

**MATERIAL REQUIREMENTS.** Security bollards shall meet the following:

Galvanized Coatings and Repair Methods	719-01
Standard Test Method for Crash Testing of Vehicle Security Barrier	ASTM F2656
Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates	SD-STD-02.01, Rev. A

**Bollard System.** The bollard design (single bollard or array) shall be crash-test-certified to

- SD-STD-02.01, Rev. A K12, or
- ASTM F2656 Impact Condition Designation M50, Penetration Rating P1.

The bollards shall have the capability of stopping a 15,000 lb truck traveling at speeds up to 50mph.

All welded joints shall be performed by welders certified to AWS D1.1.

Any bollard covers or special finishes (e.g. powder coating, painting etc.) shall be as specified in the contract documents.

The manufacturer shall supply supporting documentation as noted in AWS D1.1., ASTM F2656 and SD-STD-02.01, Rev. A and §106-04 *Material Certification and Approved List*. The documentation shall certify that the units are fabricated in accordance with the required standards, test methods and specifications. Only those bollards (single unit) or bollard arrays (multiple units) that have been tested and found to meet the test condition designations listed above shall be eligible to be placed on the Department's Approved List.

Security bollard manufacturer shall also certify that the bollard(s):

- conforms to §106-11 - Buy America,
- is installed with either a shallow foundation 24" or less below grade; or a deep foundation more than 24" below grade, and,
- exclusive of sleeve or cover, is stainless steel or metal that has been galvanized prior to final finishing (i.e. painting or powder coating).

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer. Upon approval by the Materials Bureau, the product will be placed on the Approved List.

To be considered, bollards and bollard arrays will meet the following requirements:

- Security bollard manufacturers certification, as described under §106-04 *Material Certification and Approved List*, that units are fabricated in accordance with this specification.
- Certification that the bollard or bollard array has been tested for and passed either the:
  - US Department of State's crash certification SD-STD-02.01, Rev. A, K12 Rating, or
  - ASTM F2656 certification for M50 P1 crash rating.
- Certification that all welds have been performed by welders certified to AWS D1.1.
- Manufacturer's detail of the bollard/bollard array installation needed to achieve the crash certification rating.

The details shall be in conformance with those required in ASTM F2656:

§8.1.1.2 Each drawing shall identify the barrier in exact detail. Assembly drawings shall show the arrangement, locations and dimensions of all components.

§8.1.1.3 Specifications for materials used, location and type of all welds, and size and spacing of all rebar shall be included in the documents.

**BASIS OF ACCEPTANCE.** Materials will be accepted based on the manufacturer's name and location appearing on the Approved List and a material certification that indicates that the product conforms to this specification.

**710-99 FOR SITE MANAGER USE**

## **SECTION 711 - CONCRETE CURING MATERIALS AND ADMIXTURES**

## 711-01 FIBERS FOR CONCRETE REINFORCEMENT

**SCOPE.** This specification covers the material requirements for fibers for concrete reinforcement.

**MATERIAL REQUIREMENTS.** Synthetic, fibrillated fibers, specifically engineered and manufactured for use as secondary concrete reinforcement meeting ASTM C1116 Type III.

**BASIS OF ACCEPTANCE.** Acceptance will be based on the product name and manufacturer appearing on the Department's Approved List and material certification that states the product conforms to this specification.

## 711-02 QUILTED COVERS (FOR CURING)

**SCOPE.** These specifications cover cotton mats to be used for curing Portland Cement concrete pavements and bases, and concrete structures.

**GENERAL.** The mats shall consist of a filling material of cotton "bat" or "bats" covered with unsized cloth, and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.

### MATERIALS REQUIREMENTS

**Cotton.** Cotton cloth covering shall weigh not less than 6.3 ounces per square yard and shall have an average of not less than 32 threads in warp and not less than 28 threads in filling, having a minimum average breaking strength (grab method) of 60 pounds in the warp and of 60 pounds in the filling.

The weight of the cotton cloth covering shall not fall below the specified weight by more than 5 percent. The raw materials used in the manufacture of the cotton cloth shall be raw cotton, cotton comber waste, cotton card strip waste, or combination thereof. The other physical characteristics of the cloth shall be equal to those in such material for industrial purposes.

**Burlap or Jute.** Burlap or jute covering for cotton mats shall weigh not less than 6.7 ounces per square yard and shall have not less than 8 threads per 1 inch of warp and not less than 8 threads per 1 inch of filling. It shall be the grade known commercially as "firsts" and shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability. A tolerance in weight of minus 5 percent will be permitted.

**Filling Material.** The filling material for the mats shall be cotton bat, or bats, made of raw cotton, cotton waste, cotton linters, or combinations thereof, and shall weigh not less than 12 ounces per square yard. The batting used shall not be lower in quality than a batting made of U. S. Standard Grade No. 3 Linters.

### Thread

**A. Tufting.** The cotton thread for tufting shall be not less than 4-cord number 12's.

**B. Sewing or Stitching.** The thread used for all sewing or stitching shall be at least equivalent in size and strength to standard 3-cord number 30 cotton thread.

### DIMENSIONS

**A. Mats.** Mats shall have a filler of 5 feet 9 inches in width and shall have a flap 6 inches or more in width, consisting of an extension of two thicknesses of the covering material, extending along one longitudinal edge of the mat. The length of the mats shall be 2 feet 6 inches greater than the width of pavement slab to be cured.

**B. Tolerance.** The length or width of the mats shall not be less than that specified by more than 2 percent.

## **FABRICATION**

**A. Covering Material.** The covering material for each surface of the mat shall consist of two widths of cloth joined by a lapped seam or by a seam formed by superimposing the two widths and uniting them by one row of stitches. If the seam of the latter type, the edges shall be on the inside of the finished mat.

**B. Filling.** The cotton filling materials in the form of a bat or bats shall be held in place between the coverings by sewing or tufting all around the periphery of the mat within 1 inch of each of the four edges of the filler, and by sewing or quilting longitudinally at intervals not greater than 4 inches, or by tufting at intervals both longitudinally and transversely, not greater than 3 inches. The sewing or tufting shall be sufficiently loose to permit substantially all of the surface of the mat to come in contact with a flat surface when in use, but not so loose as to permit the filling material to shift.

**C. Flap and Ends.** The flap shall be constructed by sewing the upper and lower covering together longitudinally within 1 inch of the outer edges of the flap. Along the edge of the mat opposite the flap, the filling materials shall be within 1 inch of the edges of the covering material, and the covering material shall be sewn together so as to enclose the filling material. The ends of the mats shall be finished by running an additional seam (i.e., a seam in addition to the seam holding the filling material in place) across the mats. This seam shall not be closer to the seam holding the filling material in place than 1/4 inch and not closer to the end of either covering than 1/2 inch, unless the ends of the mat are finished with an overlying or whip stitch, or in a manner which will not leave a raw edge.

**D. Stitching.** All longitudinal sewing or quilting shall average at least three stitches per 1 inch and shall have not less than five stitches in any 2 inches. All other sewing shall average six stitches per 1 inch and shall have not less than nine stitches in any 2 inches.

**BASIS OF ACCEPTANCE.** Quilted covers (for curing) will be accepted on the basis of a material certification that specifies the product conforms to this specification.

### **711-03 PLASTIC COATED FIBER BLANKETS (FOR CURING)**

**SCOPE.** These specifications cover white plastic coated fiber blankets or white plastic coated absorbent synthetic fabric blankets.

**MATERIAL REQUIREMENTS.** The blankets shall conform to the test requirements of A.S.T.M. C171, for White burlap - polyethylene sheets, for Moisture Loss and Reflectance.

**BASIS OF ACCEPTANCE.** Application for approval of plastic fiber blankets shall be submitted to the Director, Materials Bureau. Upon approval, the name and manufacturer of the product will be placed on the Department's Approved List. Each roll of the blankets shall be marked with an indelible marking, every 10 feet, with the following.

- Manufacturer's name and/or logo
- Product name
- Meet ASTM C171, White Burlap - Polyethylene Sheets, for Moisture Loss and Reflectance

The product shall be accepted at the work site on the basis of the appearance of the name and manufacturer of the product on the Approved List and marking as required herein.

#### **711-04 POLYETHYLENE CURING COVER (WHITE OPAQUE)**

**SCOPE.** This specification covers the material requirements for polyethylene curing covers (white opaque) to be used for curing of Portland Cement concrete.

**MATERIAL REQUIREMENTS.** The blankets shall conform to the material requirements of AASHTO M171 (ASTM C171) for Polyethylene Film: White Opaque. Rolls shall be wound on serviceable handling members which extend beyond the edges of the roll, forming handles to facilitate applying the covers over concrete.

**BASIS OF ACCEPTANCE.** Each shipment shall be accompanied by the manufacturer's certificate attesting to the fact that the shipment meets the specified standards. Upon request, the manufacturer shall supply a record of the results of the prescribed tests as made on the samples.

#### **711-05 MEMBRANE CURING COMPOUND**

**SCOPE.** This specification covers white-pigmented and clear membrane curing compound material and quality requirements for spray application on surfaces of newly placed Portland Cement concrete.

**GENERAL.** Samples of membrane curing compound shall be submitted to the Materials Bureau by the manufacturer upon application for approval. Approved material shall be delivered to the work site in clean containers. The curing compound shall be agitated mechanically to a uniform consistency throughout the container immediately before use.

#### **MATERIAL REQUIREMENTS**

**A. White Pigmented.** The compound shall consist of finely ground white pigment and wax-free vehicle, ready mixed for immediate use without alteration. When applied to freshly placed damp concrete at the rate of one gallon per 150 square feet, the compound shall adhere and present a uniform white appearance and effectively obscure the original color of the concrete. The compound applied at the specified rate shall provide a curing compound displaying the following properties:

- 1. Drying.** The compound shall produce a uniform coating at a minimum temperature of 40°F and shall dry track-free within 4 hours.
- 2. Permeability.** The moisture loss through the membrane shall be no more than 0.04 grams per square centimeter of surface area after three days.
- 3. Reflectivity.** The membrane shall have a reflectance value of 60 percent, minimum based on Magnesium Oxide as a standard.
- 4. Durability.** The membrane shall remain intact for at least seven days before becoming powdery and non-adherent due to weathering.

**B. Clear.** The compound shall consist of a wax-free vehicle, ready mixed for immediate use without alteration containing a fugitive dye that will fade uniformly. When applied to freshly placed, damp concrete, at the rate of 1 gallon per 150 square feet, it shall provide a curing membrane displaying the following properties :

**1. Drying.** The compound shall produce a uniform coating at a minimum temperature of 40°F and shall dry tack-free within 4 hours.

**2. Permeability.** The moisture loss through the membrane shall be no more than 0.04 grams per square centimeter of surface after three days.

**3. Durability.** The membrane shall remain intact for at least 7 days.

**4. Fugitive Dye.** The membrane-forming compounds with fugitive dye shall be readily distinguishable upon the concrete surface for at least 4 hours after application, but shall become inconspicuous within 7 days after application.

**TESTS.** The properties of a membrane curing compound shall be tested on laboratory specimens. Details of the tests may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** The approval of the membrane curing compound shall be based upon tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on an Approved List. Such products shall then be accepted on the basis of the brand name labeled on the container.

#### **711-06 BURLAP**

**SCOPE.** This specification covers requirements for burlap for use in curing concrete.

**MATERIAL REQUIREMENTS.** Burlap shall conform to the requirements of AASHTO M182. The burlap shall be made from jute or kenaf and shall weigh 10 to 12 ounces per linear yard on a 40 inch basis. Burlap shall be cleaned and free from cuts, tears, uneven weaving and contaminants.

**BASIS OF ACCEPTANCE.** The burlap will be accepted on the basis of a visual inspection by the Engineer and weighing of a sample at the point of use.

#### **711-07 FORM INSULATING MATERIALS FOR COLD WEATHER CONCRETING**

**SCOPE.** This specification covers the material requirements for form insulating materials used for cold weather concreting operations.

**GENERAL.** Insulating materials shall be:

- Impervious to moisture penetration and absorption
- Uniform in thickness
- Durable
- Easy to apply
- Capable of maintaining consistent concrete temperature
- Be in good condition with no ragged or open edges, cracks or holes



## **MATERIAL REQUIREMENTS.**

**Insulation Blankets:** Shall be clearly labeled with the manufacturer's name and the material's thermal resistivity (R value).

**Foam Boards:** Boards must be made of Expanded Polystyrene and shall be clearly labeled with the manufacturer's name and the material's thermal resistivity (R value).

**Sprayed Foam:** This product must meet the requirements of ASTM C1029.

**BASIS OF ACCEPTANCE.** The Contractor shall provide a material certification from the manufacturer that the insulating material meets the requirements of this specification and that the product R value is the same as labeled on the product.

## **711-08 ADMIXTURES**

**SCOPE.** These specifications cover the material requirements for air-entraining, water-reducing and retarding, water-reducing (normal range and high range), and non-chloride accelerating admixtures used in the manufacture of Portland Cement concrete.

**GENERAL.** All admixtures shall be in liquid form having a consistency that flows readily. The admixtures shall not contain chemicals which, when mixed with concrete, produce a condition that is injurious to the quality and durability of the concrete or reinforcing steel. This applies specifically to compounds which, when used in manufacturing process, produce a significant amount of chloride ions in the final product. (Total chloride ion content shall be less than 1000 ppm.) Admixtures manufactured from carbohydrates such as sucrose (table sugar), glucose, and maltose when used alone will not be permitted.

## **MATERIAL REQUIREMENTS**

**Air-Entraining.** The air-entraining agent shall entrain air in the concrete and the concrete containing an air-entraining agent shall conform to the following requirements:

**A. Bleeding.** The bleeding of the concrete made with the admixture under test shall not exceed that of concrete made with the reference admixture by more than 2 percentage points, the bleeding being computed as a percentage of the net amount of mixing water in each concrete. The net mixing water is the water in excess of that present as absorbed water in the aggregate.

**B. Time of Setting.** The initial time of setting of concrete containing the admixture under test shall not deviate from that of the concrete made with the reference admixture by more than  $\pm 1$  hour and 15 minutes.

**C. Compressive Strength.** The compressive strength of concrete containing the admixture under test shall be not less than 90 percent of the control concrete, at the same air content, containing the reference admixture at 48 hours, 7 days and 28 days.

**D. Resistance to Freezing and Thawing.** The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

**E. Length Change.** Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than  $\pm 20\%$  of similar concrete containing the reference admixture.

**Non-Chloride Accelerating Admixtures.** Non-chloride accelerating admixtures shall conform to the requirements outlined in ASTM C494 for Type C or Type E admixtures.

**Water-Reducing and Retarding Admixtures (ASTM TYPE D).** The water-reducing and retarding admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency, and retard the setting of concrete. Concrete containing this admixture shall conform to the following requirements:

**A. Water Reduction.** The mixing water required for concrete containing the admixture under test shall be reduced at least 5.0 percent when compared to that of the reference concrete without the admixture under test.

**B. Time of Setting.** The initial set time of the concrete containing the admixture under test shall be increased by at least 50 percent when compared to that of the reference concrete without the admixture under test.

**C. Compressive Strength.** The compressive strength of the concrete containing the admixture under test, when compared to concrete without the admixture under test, shall be equal or greater at 48 hours, 7 days and 28 days.

**D. Resistance to Freezing and Thawing.** The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent, in 25 cycles in a 10% NaCl solution.

**E. Length Change.** Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than  $\pm 35\%$  of similar concrete containing the reference admixture.

**Water-Reducing Admixtures (ASTM TYPE A).** The water-reducing admixtures shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall meet the requirements of the water reducing and retarding admixtures above except that the time of setting of the concrete containing the admixture under test shall not deviate from that of similar concrete without the admixture under test used as a reference by more than  $\pm 1$  hour and 15 minutes.

**Water-Reducing (High Range) Admixtures (ASTM TYPE F).** The water-reducing (High Range) admixture shall reduce the quantity of mixing water required to produce concrete of a given consistency. Concrete containing this admixture shall conform to the following requirements:

**A. Water Reduction.** The mixing water required for concrete containing the admixture under test shall be reduced at least 12.0 percent when compared to that of the reference concrete without the admixture under test.

**B. Time of Setting.** The initial set time of the concrete containing the admixture under test when compared to that of the reference concrete shall not be more than 1 hour earlier nor 1 hour, 30 minutes later.

**C. Compressive Strength.** The compressive strength of the concrete containing the admixture under test when compared to concrete without the admixture under test shall be as follows:  
Compressive Strength, minimum percent of control:

1 day	140%	7 days	115%
3 days	125%	28 days	110%

The compressive strength of the concrete containing the admixture under test at any test age shall be not less than 100% of that attained at any previous age.

**D. Resistance to Freezing and Thawing.** The hardened concrete containing the admixture under test shall not exceed a weight loss of 4.0 percent in 25 cycles in a 10% NaCl solution.

**E. Length Change.** Length changes shall be based on initial measurements taken at the time of removal of the specimens from the molds and final measurements taken at the end of 14 days of air drying. The specimens shall be moist-cured for 14 days followed by 14 days of air drying. Length change shall not be greater than  $\pm 35\%$  of similar concrete containing the reference admixture.

**SAMPLING AND TESTING.** A one quart sample of admixture shall be submitted to the Materials Bureau by the manufacturer applying for approval, except that for Water-reducing (High Range) admixtures, two quarts will be required. The manufacturer shall submit information on the formulation of the product including the raw materials from which it is compounded, data from tests performed in accordance with these specifications and a description of the manufacturing process. Data from tests performed in accordance with ASTM C260 for air-entraining agents and ASTM C494 for water-reducing and retarding, water-reducing (normal range and high range), and non-chloride accelerating admixtures may be substituted.

The Department will test the submitted admixture sample according to written Department instructions. The test procedures are available from the Materials Bureau upon request.

The Department reserves the right to monitor the performance of any previously approved admixture. Samples of admixture may be taken from actual concrete operations and retested by the Materials Bureau.

**BASIS OF APPROVAL.** The approval of the admixture shall be based upon the submitted information and tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Admixtures will be accepted on the basis of the brand name appearing on the Approved List and the product containers plainly labeled with the brand name.

Any admixtures sampled from actual concrete operations and retested in the Materials Bureau shall give substantially the same results, at the same dosage rate, as the original tests. Any significant change will be cause for rejection of that material and may require a resubmission of the admixture by the manufacturer for a complete retest to determine specification compliance. The admixture may be withdrawn from the Approved List during the retest period.

## 711-09 EMULSIFIED CARBON BLACK

**SCOPE.** This specification covers the material requirements for Emulsified Carbon Black, which is used as a coloring agent in mortar or concrete.

**GENERAL.** The method of test shall conform to the requirements of AASHTO T 106, the standard method of test for compressive strength of hydraulic cement mortars.

**MATERIAL REQUIREMENTS.** Emulsified Carbon Black shall be a uniform colloidal dispersion of standard carbon black in a liquid medium. The air content of the concrete shall not be changed by more than 10% by addition of 2%, by weight of cement, of the dispersed carbon black. The ash content shall not exceed 3% by weight of the finished product. At least 25% of the commercial product shall be carbon black.

The Emulsified Carbon Black shall be stable and shall have the same effect on the air entrainment, after standing for a period of 28 days, as specified above.

The color produced on the broken surface after the seven day test shall be equal to that produced by a previously established standard of color.

The Emulsified Carbon Black shall show uniform dispersion in mortars or concrete when used in concentrations necessary to produce the desired pigmentation.

**TEST.** Test specimens shall be prepared as follows: Portland Cement Type 2 containing 2% by weight of Emulsified Carbon Black shall be used with standard Ottawa Sand to prepare 1:2.75 compressive cubes. The compressive strength of these cubes at the age of seven days and thereafter shall be not less than 85% of the strength of similar cubes with no pigment added.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at manufacture of supply locations in accordance with procedural directives of the Materials Bureau.

## **711-10 FLY ASH**

**SCOPE.** This specification covers the material requirements for fly ash when used as a partial replacement for Portland Cement in Portland Cement concrete.

**MATERIAL REQUIREMENTS.** Fly ash shall conform to the chemical and physical requirements for Mineral Admixture, Class F listed in AASHTO M 295 including Table 2 (except for Footnote A). Loss of Ignition shall not exceed 4.0%.

**A. Storage.** The fly ash shall be stored at its source of supply in weather-tight silos approved by the Director, Materials Bureau. All silos shall be completely empty and clean before fly ash is deposited therein unless the silo contains fly ash of the same type.

Fly ash remaining in bulk storage at the source of distribution terminal for a period greater than one year after completion of tests will be resampled and retested by the Materials Bureau before shipment or use. However, fly ash which has been in bulk storage at sources or distribution terminals more than two years from the time of original manufacture shall not be used.

**B. Shipment.** All shipments of fly ash shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk fly ash shipment shall be of a type approved by the Director, Materials Bureau. The compartments of all such conveyances shall be completely empty and clean before any fly ash is deposited therein.

**C. Inspection and Testing.** Inspection and testing shall be in accordance with procedural directives by the Materials Bureau. Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 295 as modified in test methods prescribed by the Materials Bureau.

**Special Note.** The Department will consider requests to evaluate alternate classes of fly ash, such as Class C or N. The Department's evaluation may include laboratory testing, field trials and other related work required to determine equivalency with specified materials, mix designs, and performance. Use of alternates is subject to approval by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** Fly ash will be considered for acceptance at the source or terminal locations in accordance with procedural directives issued by the Materials Bureau.

## 711-11 MICROSILICA

**SCOPE.** This specification covers the material requirements for Microsilica (Silica Fume) for use in enhancing the performance properties of Portland Cement Concrete, shotcrete and other mixtures.

**GENERAL.** Supply Microsilica admixture in bulk form as a dry powder. When necessary for testing purposes, or in special placement situations, the admixture may be supplied in bags or barrels.

**MATERIAL REQUIREMENTS.** For approved list consideration, submit supporting documentation showing conformance with the standard and optional physical and chemical requirements of AASHTO M 307 *SILICA FUME*, and the following:

**Uniformity of Silicon Dioxide Content:** Maximum +/- 7.0% variation between any two samples.

**Chloride Content:** 0.20% maximum (as determined by AASHTO T 260, Procedure B).

**Fineness:** *Undensified powder:* 10% maximum percent retained on the No. 325 sieve (AASHTO T 192).

**MONITOR SAMPLING.** For monitor sampling of previously approved materials, follow the procedures directed in Materials Procedure 90-1 or Materials Method 10. The Department will monitor the product for conformity with the standard physical and chemical requirements of AASHTO M 307 at its discretion.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall submit one 5 gallon sample of the admixture for each manufacturing or supply location to the Materials Bureau.

Provide a Quality Control report for each manufacturing or supply location. The report will be required prior to Departments evaluation of the product, and annually thereafter. Details of the Quality Control report are available from the Materials Bureau. If the material will be manufactured or supplied from multiple locations, identify each location separately. Submit a separate sample and Quality Control Report for each manufacturing or supply location.

Submit laboratory test results from a testing laboratory that is accepted by the Cement and Concrete Reference Laboratory (CCRL) indicating conformance to this specification. For each sample submitted for approved list evaluation, provide a certification declaring conformance to this, and the applicable AASHTO specification, the production lot number, the date of manufacture, and the date tested. Clearly state the chemical and physical properties as required by AASHTO M 307, and the pH of the material. Provide supporting data, relative to these specifications, detailing the performance of the product when used in concrete mixtures. Provide a manufacturer's label clearly stating the product and manufacturer's name and a Material Safety Data Sheet for each product submitted for approved list evaluation.

The Department will test the submitted sample in accordance with these specifications and Department instructions. The review process requires a minimum of 30 calendar days. Test procedures are available from the Materials Bureau upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Each shipment will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List, and a material certification indicating conformance to this specification. The Department reserves the right to monitor the performance of any previously approved Microsilica from concrete production. If the monitor test results indicate that the sampled product does not meet this specification, the concrete incorporating the product represented by the sample may be rejected.

## **711-12 GROUND GRANULATED BLAST- FURNACE SLAG**

**SCOPE.** This specification covers the material requirements for ground granulated blast-furnace slag when used as a partial replacement for portland cement in portland cement concrete.

**MATERIAL REQUIREMENTS.** Ground Granulated Blast Furnace Slag (GGBFS) shall conform to the chemical and physical requirements for Grade 100 or 120, as classified in AASHTO M 302.

**Storage.** The ground granulated blast-furnace slag shall be stored at its source of supply in approved weather-tight silos. Facilities shall be provided for maintaining such silos under Department seal control when and as directed by the Materials Bureau. All silos shall be completely empty and clean before GGBFS is deposited therein unless the silo contains Department specification GGBFS of the same type.

GGBFS remaining in bulk storage at the mill and/or distribution terminal for a period greater than one year after completion of tests shall be resampled and retested before shipment. However, GGBFS which has been in bulk storage at mills and/or distribution terminals more than two years from the time of original manufacture shall not be used. No GGBFS stored by the Contractor over the winter shall be used until retested by the Materials Bureau.

**SHIPPING.** All shipments of ground granulated blast-furnace slag shall be made in accordance with procedural directives issued by the Materials Bureau. Conveyances for bulk shipment shall be of a type approved by the Department. The compartments of all such conveyances shall be completely empty and clean before any GGBFS is loaded therein.

**INSPECTION AND TESTING.** All inspection and testing shall be in accordance with procedural directives issued by the Materials Bureau. When required by the Materials Bureau, GGBFS shall be sampled by means of an automatic sampling device constructed so as to obtain continuous samples across the full stream of GGBFS and deliver such samples into a sealed container approved by the Materials Bureau.

Tests for chemical and physical properties shall be in accordance with test methods stipulated by AASHTO M 302.

**BASIS OF ACCEPTANCE.** Ground granulated blast-furnace slag will be considered for acceptance at mill or terminal locations in accordance with procedural directives issued by the Materials Bureau.

## **711-13 CALCIUM NITRITE BASED CORROSION INHIBITORS**

**SCOPE.** This specification covers the material requirements for corrosion inhibitors used in the manufacture of Portland Cement Concrete.

**GENERAL.** The corrosion inhibitor shall consist of a calcium nitrite solution. The admixture shall not contain chemicals which, when mixed with concrete, produce a condition that is injurious to the quality and durability of the concrete or reinforcing steel.

**MATERIALS REQUIREMENTS.** The corrosion inhibitor shall consist of a calcium nitrite solution , containing 30 +/- 2% calcium nitrite solids by weight and having a specific gravity of 1.27 +/- 0.02. The corrosion inhibitor when used in the manufacturing process shall not produce a significant amount of chloride ions in the final product ( Less than 1000 ppm, as determined by the Department). The pH shall be greater than 8.

**SAMPLING AND TESTING.** A two quart sample of admixture shall be submitted to the Materials Bureau by the manufacturer applying for approval. Along with the sample, the Manufacturer shall provide information to include the manufacturer's name and address, a copy of the product literature, material safety data sheets, and written certification stating that the material meets the physical and chemical requirements of this specification ( 711-13, Calcium Nitrite Based Corrosion Inhibitors ).

The Department will test the sample for specific gravity and percent calcium nitrite in accordance with written Department instructions. The Sampling and testing procedure is available from the Materials Bureau upon request. Upon testing by the Materials Bureau, if the sample submitted is within tolerance, it will be placed on the Department's Approved List of Materials for corrosion inhibitors. In order to ensure their quality, regular monitor sampling and testing will be performed at the point of use. The concrete batching facility is typically the point of use.

**BASIS OF ACCEPTANCE.** The initial approval of the admixture shall be based upon the submitted information and tests performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List. Such products shall then be accepted on the basis of the brand name labeled plainly on the containers.

#### **711-14 HIGH REACTIVITY POZZOLAN**

**SCOPE.** This specification covers the material requirements for High Reactivity Pozzolan for use in enhancing the performance properties of Portland Cement Concrete, shotcrete and other mixtures.

**GENERAL.** Supply the High Reactivity Pozzolan admixture in bulk form as a dry powder. When necessary for testing purposes, or in special placement situations, the admixture may be supplied in bags or barrels.

**MATERIAL REQUIREMENTS.** For approved list consideration, submit supporting documentation showing conformance with the standard and optional physical and chemical requirements of AASHTO M 321 *HIGH REACTIVITY POZZOLANS FOR USE IN HYDRAULIC CEMENT CONCRETE, MORTAR, AND GROUT*, and the following:

**Uniformity of Reactive Oxides:** Maximum +/- 7.0% variation between any two samples.

**Chloride Content:** 0.20% maximum (as determined by AASHTO T 260, Procedure B).

**Fineness:** 10% maximum percent retained on the No. 325 sieve (AASHTO T 192).

**MONITOR SAMPLING.** For monitor sampling of previously approved materials, follow the procedures directed in Materials Procedure 90-1 or Materials Method 10. The Department will monitor the product for conformity with the physical and chemical requirements of AASHTO M 321 at its discretion.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall submit one 5 gallon sample of the admixture for each manufacturing or supply location to the Materials Bureau.

Provide a Quality Control report for each manufacturing or supply location. The report will be required prior to Departments evaluation of the product, and annually thereafter. Details of the Quality Control plan are available by contacting the Materials Bureau. If the material will be manufactured or supplied from multiple locations, identify each location separately. Submit a separate sample and Quality Control Report for each location.

Submit laboratory test results from a testing laboratory that is accepted by the Cement and Concrete Reference Laboratory (CCRL) indicating conformance to this specification. For each sample submitted for approved list evaluation, provide a certification declaring conformance to this, and the applicable AASHTO specification, the production lot number, the date of manufacture, and the date tested. Clearly state the chemical and physical properties as required by AASHTO M 321, and the pH of the material. Provide supporting data, relative to these specifications, detailing the performance of the product when used in concrete mixtures. Provide a manufacturer’s label clearly stating the product and manufacturer’s name and a Material Safety Data Sheet for each product submitted for approved list evaluation.

The Department will test the submitted sample in accordance with these specifications and Department instructions. The review process requires a minimum of 30 calendar days. Test procedures are available from the Materials Bureau upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Each shipment will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List, and a material certification indicating conformance to this specification. The Department reserves the right to monitor the performance of any previously approved High Reactivity Pozzolan from actual concrete production. If the monitor test results indicate that the sampled product does not meet this specification, the concrete incorporating the product represented by the sample may be rejected.

**711-15 MISCELLANEOUS SUPPLEMENTARY CEMENTITIOUS MATERIALS**

**SCOPE.** This specification covers the material requirements for *Miscellaneous Supplementary Cementitious Materials* for use as a partial replacement for ordinary Portland cement (OPC) in enhancing the performance properties of Portland Cement Concrete, shotcrete and other mixtures.

**GENERAL.** Supply the *Miscellaneous Supplementary Cementitious Materials* in bulk form as a dry powder. When necessary for testing purposes, or in special placement situations, the admixture may be supplied in bags or barrels.

**MATERIAL REQUIREMENTS.** For approved list consideration, submit supporting documentation showing the beneficial use of the product relative to the enhancement of physical properties of concrete mixtures as per the requirements in Table 711-15-1:

<b>TABLE 711-15 - 1 PHYSICAL AND CHEMICAL PROPERTIES</b>	
<b>PROPERTY</b>	<b>REQUIREMENT</b>
Fineness (AASHTO T 192)	10% maximum percent retained on the 45-µm (#325) sieve.
Compressive Strength (AASHTO T 22)	Set of 2 cylinders tested at 3, 7, 14, 28, and 56 days. At least two concrete test batches must contain 10% and 20% replacement for OPC and compare to a reference mixture containing 100% OPC. Compressive strength of each test batch must equal or exceed 85% of the reference batch @ 28 days.



Permeability (AASHTO T 277)	Avg. of 3 specimens sampled from each test batch described above. Total average charge passed must be $\leq$ than the reference batch @ 56 days.
Strength Activity Index (ASTM C 311)	85% minimum @ 28 days using 30% replacement for OPC.
Alkali Silica Reactivity (ASTM C441)	35% minimum reduction of mortar expansion @ 14 days using 10 and 20% replacement for OPC.
Reactive Oxides (Al <sub>2</sub> O <sub>3</sub> , + SiO <sub>2</sub> + Fe <sub>2</sub> O <sub>3</sub> ) (AASHTO T105)	70% minimum.
Uniformity of Reactive Oxides	$\square \pm 7.0\%$ maximum variation between any two samples.
Chloride Content (AASHTO T 260 Proc. B)	0.20% maximum.
LOI (ASTM C 311)	6.0% maximum.
SO <sub>3</sub> (ASTM C 311)	3.0% maximum.
Moisture Content (ASTM C 311)	3.0% maximum.

**MONITOR SAMPLING.** For monitor sampling of previously approved materials, follow the same procedures as directed in Materials Method 10 for High Reactivity Pozzolans. The Department will monitor the product for conformity with the physical and chemical requirements at its discretion.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall submit a sample of the admixture for each manufacturing or supply location to the Materials Bureau in accordance with Materials Method 10 (for High Reactivity Pozzolans). Provide a Facility Report for each manufacturing or supply location. The report will be required prior to Departments evaluation of the product, and annually thereafter. Details of the Facility Report outline are available by contacting the Materials Bureau. If the material will be manufactured or supplied from multiple locations, submit a separate sample and Facility Report for each location. Submit laboratory test results from a testing laboratory that is accepted by the Cement and Concrete Reference Laboratory (CCRL) indicating conformance to this specification. For each sample submitted for approved list evaluation, provide a certification declaring conformance to this specification, the production lot number, the date of manufacture, and the date tested. Clearly state the chemical and physical properties as required by this specification, and the pH of the material. Provide supporting data, relative to these specifications, detailing the performance of the product when used in concrete mixtures. Provide a manufacturer's label clearly stating the product and manufacturer's name and a Material Safety Data Sheet for each product submitted for approved list evaluation. The Department will test the submitted sample in accordance with these specifications and Department instructions. Test procedures are available from the Materials Bureau upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Each shipment will be considered for acceptance where it will be incorporated into the concrete. Acceptance will be based on the product name appearing on the Approved List, and a material certification indicating conformance to this specification. The Department reserves the right to monitor the performance of any previously approved cementitious material from actual concrete production. If the monitor test results indicate that the sampled product does not meet this specification, the concrete incorporating the product represented by the sample may be rejected.

#### 711-99 FOR SITE MANAGER USE

**SECTION 712 - MISCELLANEOUS**  
 (Last Revised January, 2020)

**712-01 WATER**

**SCOPE.** This specification contains the requirements for water used in Portland Cement concrete, mortar, concrete curing, treated subgrade, soil cement and for application to plants, seeded or sodded areas and planted areas.

**MATERIAL REQUIREMENTS.** Water used for mixing and curing Portland Cement concrete, mortar, treated subgrade and soil cement shall meet the requirements indicated in Table 712-1, Water. NYSDOT Test Method No. 712-01P shall apply to all Physical tests.

Water for curing concrete shall not contain any impurities in sufficient amount to cause discoloration or surface deterioration.

Water applied to seeded or sodded areas, plants or planted areas shall be free from oil, have a pH not less than 6.0 nor greater than 8.0 and shall be free from impurities injurious to vegetation.

**BASIS OF ACCEPTANCE.** Municipal water supplies are considered acceptable sources. Acceptance of questionable sources of water, as determined by the Regional Director or his/her representative, shall be determined by the Materials Bureau on samples taken by Department representatives.

<b>TABLE 712-1 WATER</b>	
Air Content of Mortar, percent by volume	12.0 Max.
Soundness, Autoclave Expansion, percent	0.50 Max.
Compressive Strength,	90 Min.
7 day, 28 day (optional) percent of compressive strength of mortar cubes made with standard water	
Time of Setting, Vicat Test,	
Initial Set, minutes	45 Min.
Final Set, hours	8 Max.
Presence of Oil	None
pH, AASHTO T26	5.0 - 8.5
Organic Solids, AASHTO T26, ppm	200 Max.
Total Inorganic Solids, AASHTO T26, ppm	2000 Max.
Chloride Ion Content, ppm	500 Max.
Sulphate Ion Content, ppm	1000 Max.

**712-02 CALCIUM CHLORIDE**

**SCOPE.** This specification covers the material requirements for calcium chloride for use in dust control, stabilization, ice control and for other highway construction related purposes.

Calcium chloride material shall be either Type A - Solid Flake Calcium Chloride or Type B - Liquid Calcium Chloride Solution.

**MATERIAL REQUIREMENTS**

*Type A - Solid Flake Calcium Chloride.* Solid Flake Calcium Chloride shall meet the requirements of ASTM D98 and upon analysis shall show not less than 77.0% CaCl<sub>2</sub>. The calcium chloride shall be supplied in the form of dry, loose flakes, pellets or granules and shall be fine enough to feed through the common types of spreaders used in roadwork. The Engineer reserves the right to reject any material that has become caked or otherwise damaged.

**Type B - Liquid Calcium Chloride Solution.** Liquid Calcium Chloride shall be supplied as a mixed solution which upon analysis shall show not less than 30.0% of CaCl<sub>2</sub>.

**Equivalent Spreading Rates.** For purposes of these specifications 1.0 lb/sy of Type A, Solid Flake CaCl<sub>2</sub> is equivalent to 0.2 gal/sy of Type B, Liquid CaCl<sub>2</sub> Solution. These factors shall be used as the basis for determining other rates of application.

## **PACKAGING, MARKING & SHIPPING**

**Type A - Solid Flake Calcium Chloride.** Solid Calcium chloride shall be packaged in moistureproof bags containing not more than 100 lbs each, or in airtight drums weighing not more than 450 lbs each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof covers. The location and protection of stockpiled material shall be approved by the Engineer prior to shipment.

The name of the manufacturer, name of the product, net weight, and the percentage of calcium chloride (CaCl<sub>2</sub>) guaranteed by the manufacturer shall be legibly marked on each container, except in the case of bulk shipments where the invoice shall be accepted as evidence of compliance with these requirements.

**Type B - Liquid Calcium Chloride Solution.** Liquid calcium chloride shall be delivered in bulk shipments on a supplied-and-applied basis. The delivery equipment shall be capable of applying the liquid solution at the specified rate(s). The delivery equipment shall be subject to approval by the Engineer and shall be equipped with suitable calibration devices to insure the correct rate of application. Each bulk shipment shall be accompanied with the manufacturer's invoice.

**BASIS OF ACCEPTANCE.** Calcium chloride will be accepted based on its use as follows:

**A. For dust control, ice control and other highway construction related purposes.** Type A and Type B calcium chloride will be accepted based on the Engineer's approval.

**B. For soil stabilization.** Type A and Type B calcium chloride will be accepted on the basis of the manufacturer's certification that the product conforms to the above specifications. The certification shall reference the number of containers shipped, or in the case of bulk deliveries, the invoice numbers associated with each delivery.

## **712-03 SODIUM CHLORIDE**

**SCOPE.** This specification covers the material requirements for sodium chloride to be used as a soil admixture or deicing agent for maintenance.

**MATERIAL REQUIREMENTS.** Sodium chloride shall meet the requirements of ASTM D632, Sodium Chloride - Type 1, Grade 1.

Sodium chloride shall be packaged in moistureproof bags containing not more than 100 lbs each, or in airtight drums weighing not more than 450 lbs each, or it may be delivered in bulk in tank cars, covered hopper cars, or covered trucks. All bulk shipments that are to be stored and stockpiled on the job site shall be protected with waterproof covers. The location and protection of stockpiled material shall be approved, by the Engineer, prior to shipment.

**BASIS OF ACCEPTANCE.** Sodium chloride will be accepted based upon the Engineer's approval.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

#### **712-04 HYDRATED LIME**

**SCOPE.** This specification contains the material requirements pertaining to Hydrated Lime.

**MATERIAL REQUIREMENTS.** Hydrated Lime shall meet the requirements of ASTM C207, Hydrated Lime for Masonry Purposes - Type NA or SA.

**BASIS OF ACCEPTANCE.** The manufacturer's certification shall constitute sufficient documentation for acceptance of this material at the site of the work. The Department reserves the right to sample this material to test for conformance to these specifications.

#### **712-05 PRECAST CONCRETE RIGHT-OF-WAY MARKERS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete right-of-way markers.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply.

Precast right-of-way markers shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the bottom end face of each unit such that they won't be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 shall apply.

#### **712-06 EXPENDABLE IMPACT ATTENUATOR**

**SCOPE.** This specification covers the material and performance requirements for expendable impact attenuators.

**MATERIALS REQUIREMENTS.** Expendable Impact Attenuator components shall meet the following requirements:

Impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds.

Covers shall be provided by the manufacturer for all units where ingress of debris from the top will result in deterioration of performance.

Metal parts shall be fabricated from M1020 Merchant Quality or ASTM A36M steel.

All galvanization shall be in accordance with §719-01 *Galvanized Coatings and Repair Methods, Type I*.

Welding shall be in accordance with the Steel Construction Manual, except radiographic inspection shall not be required.

The size and recommended attachment method for reflective marking shall be specified.

**BASIS OF APPROVAL.** Impact attenuator systems shall be NCHRP 350 approved. Impact attenuators meeting the requirements of NCHRP 350 TL-2 are acceptable only as TL-2 devices. TL-3 devices are acceptable for TL-3 and TL-2.

Manufacturers or material suppliers desiring to have impact attenuators approved shall prepare and submit Materials Details Sheets consisting of copies of drawings, specifications, test reports, and Federal acceptance letters, to the Director of the Materials Bureau. The review process requires a minimum of 45 calendar days.

**BASIS OF ACCEPTANCE.** Expendable Impact Attenuators will be accepted at the contract site on the basis of the manufacturer=s name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer=s certification that the product delivered is in conformance with these specifications.

## **712-07 INERTIAL BARRIER MODULES**

**SCOPE.** This specification covers the material and performance requirements for sand-filled inertial barrier systems used for site hazard protection.

**GENERAL.** Modules composing the array shall be free-draining with respect to residual moisture in the fill sand. Their lids shall be such that they divert precipitation and stop moisture from seeping into the shell. Lids shall be fastened with a minimum of six equally spaced pop rivets or secured by other approved fasteners so as to provide a reasonably vandal resistant, closed barrel .

**MATERIAL REQUIREMENTS.** The modules shall be federal yellow or as shown on the plans. They shall be durable, waterproof, resistant to deterioration from ultra-violet rays, deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion and contraction and fill settlement.

The fill sand shall conform to the requirements of either 703-06, Cushion Sand, or 703-07, Concrete Sand. Sodium chloride, as dry rock salt, equal to 3-5 percent by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of 712-03, Sodium Chloride.

**TESTS.** To determine the crash worthiness of inertial barrier modules not on the NYSDOT's Approved List, an array containing each size module shall be subjected to crash tests to verify that the barrier system can safely decelerate an impacting vehicle. These tests shall be done in accordance with the National Cooperative Highway Research Program Report 350, test numbers, 3-40, 3-41, 3-42, 3-43 and 3-44. Evaluation criteria shall conform to the safety evaluation guidelines found in Table 5.1, as specified in Table 3.2.

Crash cushion arrays shall be designed to conform to the occupant risk values found in NCHRP Report 350, Table 5.1, Criteria D, H and I.

Any values deviating from these shall be justified by site and/or shape limitations, or cost, and approved by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** The Department requires the submission of Materials Details. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the product and/or supplier, and the reference number assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted on the basis of their brand and conformance to the approved Materials Details.

**712-08 VACANT**  
(Last Revised May, 2019)

**712-09 FOR SITE MANAGER USE**

**712-10 WARM MIX ASPHALT TECHNOLOGIES**

**SCOPE.** This specification covers the material requirements for warm mix asphalt (WMA) technologies for use in asphalt mixtures. Warm mix asphalt technologies can either be organic or chemical additives or a foaming system. The organic, chemical, and foaming system used as additives in the Performance-Graded (PG) Asphalt Binders give the PG binder unique functional properties in the production and placement of the asphalt mixtures.

**MATERIAL REQUIREMENTS.** Warm Mix Asphalt Technologies on the Department’s Approved List:

- A. **Organic (Waxes) Additives (712-1010):** Organic waxes used as additives in Performance-Graded (PG) Asphalt Binders.
- B. **Chemical Additives (712-1020):** Chemical used as an additive in Performance-Graded (PG) Asphalt Binders.
- C. **Foaming Processes (712-1030):** A comprehensive foaming process of water mixed with Performance-Graded (PG) Asphalt binder in the production of the asphalt mixture.

Warm mix asphalt technologies shall be tested by the National Transportation Product Evaluation Program (NTPEP) in accordance with their procedures and must meet the material specification listed in the table below.

<b>Material Specification</b>	<b>Test Requirement</b>
PG Binder Properties, AASHTO M332	The resulting grade determination must not decrease more than 3 degrees from the true grade of the PG binder.
Tensile Strength Ratio (TSR), AASHTO T283	≥ 80%
Rutting Test using the Hamburg Wheel Test, AASHTO T324	WMA cannot exceed ¼ inch (6 mm) difference from the control HMA.

**BASIS OF APPROVAL.** The approval of the warm mix asphalt technologies shall be based upon satisfactory completion of the following:  
Acceptable test results from the National Transportation Product Evaluation Program (NTPEP).  
Technology Details submitted to the Materials Bureau.

Upon approval by the Materials Bureau, the name of the technology, the technology provider, a contact, and technology details will be placed on the Approved List. Resubmittal of organic and chemical warm mix technologies to NTPEP for product testing of a previously approved product is required every seven years.

**BASIS OF ACCEPTANCE.** The warm mix asphalt technology will be accepted based on the product appearing on the Approved List for the appropriate type of technology

### 712-11 ASPHALT RELEASE AGENTS

**SCOPE.** This specification covers the material requirements for asphalt release agents for use on hot mix asphalt (HMA) hauling equipment. Asphalt release agents are chemicals used for coating metal on truck beds, pavers, rollers, and hand tools to prevent the asphalt mixture from adhering to the metal.

**MATERIAL REQUIREMENTS.** Asphalt release agents must meet the following requirements:

1. The release agents shall be petroleum-free products and contain no solvents.
2. The material shall be tested by the National Transportation Product Evaluation Program (NTPEP) for asphalt release agents in accordance with their procedures and must meet the material specification listed in the table below.

Material Specification	Test Requirement
Asphalt Stripping Test	No detrimental effects on HMA sample.
Mixture Slide Test	No adherence of HMA to metal plate.

**BASIS OF APPROVAL.** The approval of asphalt release agents shall be based upon satisfactory test results from the National Transportation Product Evaluation Program (NTPEP). Upon approval by the Materials Bureau, the asphalt release brand, supplier's name and location will be placed on the Approved List. Resubmittal to NTPEP for product testing of a previously approved product is required every three years.

**BASIS OF ACCEPTANCE.** The asphalt release agent will be accepted based on the product appearing on the Approved List and the manufacturer's certification.

### 712-12 ASPHALT ROOFING FELT

**SCOPE.** These specifications contain the material requirements pertaining to Asphalt Roofing Felt.

**MATERIAL REQUIREMENTS.** Roofing shall conform to the requirements of the standard specifications for Asphalt-Saturated Roofing Felt for use in Waterproofing and in Constructing Built-Up Roofs, ASTM D226.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification of compliance with these specification requirements.

### **712-13 TIMBER AND LUMBER**

**GENERAL.** Unless otherwise specified or noted upon the plans or in the itemized proposal, timber and lumber shall be of any kind acceptable to the Engineer. The material shall be sound, square-edged, free from shakes, loose knots or decay.

### **712-14 STRESS GRADED TIMBER AND LUMBER**

**GENERAL.** Stress graded timber and lumber shall be graded for the stress grade selected, in accordance with grading rules for the indicated stress grade, developed from ASTM D245.

Commercial stress grades of timber and lumber, with grade descriptions providing material which will meet the indicated stress requirements under rules conforming to ASTM D245, will be acceptable.

**MATERIAL REQUIREMENTS.** The manufacturer shall inspect and grade the timber and lumber. Each piece shall be clearly branded with the stress grade mark of the manufacturer's inspector. Stress graded timber and lumber will be subject to inspection by representatives of the Department, to whom the manufacturer shall supply three copies of its certification of inspection and piece tally.

The Contractor shall furnish all facilities for the inspection of this material by the Department's representatives and shall allow them free access to all premises where inspections can be made.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of certification by the manufacturer that the timber and lumber has been inspected and stress graded under grading rules which conform to the requirements of ASTM D245. The certification shall show the identifying stress grade mark used by the manufacturer's inspector.

### **712-15 GABIONS**

**SCOPE.** This specification covers the material and quality requirements for galvanized gabions and galvanized with polyvinyl chloride (PVC) gabions.

**GENERAL.** The materials used in fabricating and filling of gabions shall comply to specifications and tests set forth below.

#### **MATERIAL REQUIREMENTS.**

**Gabions.** Gabions produced from twisted wire shall conform to the requirements of ASTM A975. Gabions produced from welded wire shall conform to the requirements of ASTM A974. The physical properties of the PVC coating shall conform to the requirements of ASTM A975 or ASTM A974, as appropriate.

**Tiewire or Lacing Wire.** Tiewire or lacing wire shall conform to the requirements of ASTM A975 or ASTM A974, as appropriate.

**Stone Fill.** The baskets shall be filled with approved stone of the following sizes:

<b>Basket Depth or Height</b>	<b>Minimum Stone Size</b>	<b>Maximum Stone Size</b>
12 inches	4 inches	8 inches



Greater than 12 inches	4 inches	12 inches
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The soundness of all stone used for gabions shall be approved on the basis of a geologic evaluation in accordance with the control procedure in effect on the date of advertisement for bids. Prior to the evaluation, the Contractor shall stockpile the material. Where the State elects to conduct tests, a material will be rejected if it fails to meet the following criteria:

- A. Freeze-Thaw Test. A maximum 10 percent loss, by weight, after 25 cycles of freezing and thawing.
- B. Magnesium Sulfate Soundness Test. A maximum 10 percent loss, by weight, after 10 cycles of the magnesium sulfate soundness test.

**Fabrication.** Gabions shall be supplied, as specified, in various lengths and heights. The lengths shall be multiples (2, 3, or 4) of the horizontal width. The heights shall be fractions (1, 1/2, or 1/3) of the horizontal width. The horizontal width shall not be less than 3 feet. However, all gabions furnished by a manufacturer shall be uniform width. Dimensions for height, lengths and widths are subject to a tolerance limit of  $\pm 5\%$  of manufacturer's stated sizes.

Gabions shall be fabricated in such a manner that the front, back, sides, ends, lid and diaphragms can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single-unit construction. The base, lid, ends, front and back shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh. Where the length of the gabion exceeds its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gage as the body of the gabion, forming cells such that the length does not exceed the horizontal width.

The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary. All perimeter edges of the mesh forming the gabion shall be securely selvaged so that the joints formed by tying the selvages have at least the same strength as the body of the mesh.

**BASIS OF ACCEPTANCE.** Each shipment of gabions to a job site shall be accompanied by a certification which states that the material conforms to the requirements of this specification. A shipment shall consist of all material arriving at the job site at substantially the same time. The certification shall be on company letterhead and shall be signed by an officer of the company having legal authority to bind the company.

#### **712-16 PIGMENT FOR COLORED SYNTHETIC RESIN BINDER CONCRETE**

**SCOPE.** This specification covers the material requirements for pigment used in colored synthetic resin binder concrete.

**MATERIAL REQUIREMENTS.** The pigment shall be compatible with the synthetic resin binder material and shall provide the colored synthetic resin binder concrete with a non-fading, heat stable color. When the color specified is white, the pigment shall be Rutile Titanium Dioxide.

**BASIS OF ACCEPTANCE.** Acceptance of this material shall be in accordance with procedural directives of the Department.

#### **712-17 WOOD CROSS TIES**

**SCOPE.** This specification covers the material requirements for wood cross ties for railroads.

**MATERIAL REQUIREMENTS**

**A. Species.** The following kinds of wood suitable for cross ties will be accepted.

Ash	Elm	Sassafras
Beech	Hackberry	Sycamore
Birch	Locust	Walnut
Black Gum	Maple	
Catalpa	Mulberry	
Cherry	Oak	

**B. Manufacture.** Cross ties shall be well sawed in top, bottom and sides. A cross tie shall be considered well sawed as long as score marks are not more than 1/4 inch deep and the surfaces are even.

Cross ties shall be straight, cut square at the ends, have bottom and top parallel, and have all bark entirely removed. A cross tie shall be considered straight only if it meets both of the following requirements:

1. A straight line drawn along the top of the tie from the middle of one end to the middle of the other end of the tie, falls entirely within the width of the tie.
2. A straight line drawn along a side of the tie from the middle of one end to the middle of the other end of the tie, is everywhere more than 2 inches from the top and 2 inches from the bottom of the tie.

The top and bottom of a tie will be considered parallel if any difference in the thickness at the sides or ends does not exceed 1/2 inch.

**C. Dimensions.** All thicknesses and widths apply to areas of the tie defined as the 'rail bearing area(s)'. The rail bearing areas are those areas which lie between 20 and 40 inches on both sides of the mid-point of the tie length. The rail bearing area for switch ties is the area between 12 inches from each end of the switch tie.

All determinations of width shall be made on the top of the tie. The top is defined as the narrower of the horizontal surfaces, or the surface with the least or no heartwood if both surfaces are the same width.

Standard size thickness and width dimensions are shown in Table 712-17, and apply to the rail bearing areas. The dimensions of the tie shall not be averaged. All ties shall be 8 feet 6 inches long, or as required.

<b>Size</b>	<b>Dimensions in Rail Bearing Areas</b>
5	7 in. thick by 9 in. wide (top)
4	7 in. thick by 8 in. wide (top)
3A	7 in. thick by 7 in. wide (top) minimum 8 in. wide through body
3	6 in. thick by 8 in. wide (top)
2	6 in. thick by 7 in. wide (top)
1	6 in. thick by 6 in. wide (top) minimum 7 in. wide through body

**D. Tolerances.** Individual untreated ties shall have the following tolerances applied to the thickness and width dimensions shown in Table 712-17.

Length:	plus 2 in.,	minus 1 in.
Thickness:	plus 2 in.,	minus 1/4 in.
Width:	plus 1 in.,	minus 1/4 in.

It is not the intent of this specification that all ties shall be manufactured to the minimum allowable dimensions. A minimum of 75% of the ties presented for inspection shall conform to the dimensions shown in Table 712-17 without the application of the minus tolerances.

**E. Defects.** The occurrence of any of the following defects in an individual tie shall be the cause for rejection.

**1. Shakes.** A separation along the grain, occurring between the annual growth rings. A shake length more than one-third the nominal width of the tie shall not be allowed.

**2. Slant or Slope of Grain.** Except in the case of woods with interlocking grain, a slant or slope of grain in excess of 1 in 15 shall not be allowed.

**3. Holes.** Large holes shall not be allowed. A large hole is more than 1/2 inch in diameter and 3 inches deep within the rail bearing areas, or more than one-fourth the width of the surface on which it appears and 3 inches deep outside the rail bearing area. Numerous holes shall not be allowed. Numerous holes are any number equalling a large hole in size.

**4. Knots.** Large knots shall not be allowed. A large knot is one whose average diameter exceeds one-fourth the width of the face on which it appears. Numerous knots shall not be allowed. Numerous knots are any number equalling a large knot in size.

**5. Checks.** A separation along the grain of the wood occurring across the annual rings. Fully seasoned and treated ties with check depths greater than one-fourth the thickness and longer than one-half the length of the tie shall not be allowed.

**6. Decay.** Ties shall contain no decay. Although blue stain is not considered decay and is not a defect, ties shall be inspected with extra care for presence of decay in heavily stained areas.

**7. Wane.** The lack of wood on the edge or corner of the tie due to the natural curvature of the log from which the tie is cut. Wane which reduces the face dimension greater than 3 inches outside the rail bearing area shall not be allowed. In the rail bearing area, dimensions given in Table 712-17 apply.

**8. Splits.** A split is a separation of the wood extending from one surface to an opposite or adjacent surface. In unseasoned ties, a split more than 1/8 inch wide or longer than 5 inches shall not be allowed.

After treatment, a split in either end of the tie greater than 1/8 inch wide or longer than 5 inches is not acceptable without an anti-splitting device. A split tie which has had an anti-splitting device applied but which re-opens after treatment to exceed 1/2 inch in width is not acceptable.

**9. Twist.** The deviation from a flat plane of all four faces by a spiraling or torsional action. A rotation of more than 3.5° from end face to end face shall not be allowed.

**F. Anti-Splitting Devices.** Anti-Splitting devices are to be installed prior to preservative treatment.

**1. Dowelling.** Dowels are anti-splitting devices driven or pushed into pre-bored holes. The length of dowel embedded shall not be less than half the width or thickness through which it is placed. Use of lubricants to facilitate driving of dowels is prohibited.

*a. Equipment.* These specifications are based on dowelling by mechanical dowel machines. Alternate methods may be used if the results are equal to those obtained by mechanical devices that press the tie together, drill and dowel in one or two operation. Dowelling by mechanical means is considered satisfactory as long as sufficient pressure is applied to completely close the split.

Substitution of hand drills and pneumatic hammers for drilling dowels in switch ties is satisfactory as long as splits are held closed during dowelling by the use of clamps or other devices.

*b. Pre-Drilled Holes.* The maximum diameter of the pre-drilled holes is 1/8 inch less than the diameter of dowel. The minimum length of the hole shall be equal to the length of the dowel, except that holes drilled from the face opposite the face where the dowel enters shall be completely through the tie.

*c. Location of Dowels.* Dowels shall be driven perpendicular to the face most parallel to the split. Two dowels shall be used to close each split. They shall be located a minimum of 4 inches and a maximum of 6 inches from the end of the tie. Where the tie is split parallel to the narrow faces, the 7 3/4 inches long dowels shall be located 1 1/2 inch plus or minus 1/4 inch from each wide face. Where the tie is split parallel to the wide faces, 5 3/4 inches long dowels are driven 2 inches plus or minus 1/4 inch from each narrow face.

*d. Protruding Dowels.* Dowels not completely driven by dowelling machines shall be driven flush with the wood with a hammer. Dowels which protrude more than 1/4 inch after driving should be burned off with an oxyacetylene torch. However, dowels bent over flush with the surface of the wood will be accepted, provided this is done without splitting the wood.

**2. Irons.** Anti-splitting irons are driven into the ends of ties and shall be placed to cross at right angles and the greatest possible number of radial lines of the wood. Irons shall be placed far enough from the wide faces to prevent splitting of the tie.

*a. Design.* Anti-splitting irons shall be made from a strip of steel formed to an “S” iron or “C” iron design. They will be of adequate size to prevent splitting of the tie.

*b. Material.* Irons shall conform to specifications for anti-splitting irons given in the AREA Manual, Chapter 3, Section 1.9.2.1.

**3. Nail Plates.** Anti-splitting nail plates shall be applied to the ends of the ties.

*a. Design.* Anti-splitting nail plates shall be rectangular and perforated to form multiple nails.

*b. Material.* Nail plates shall be stamped from 18 gage galvanized sheet steel.

*c. Size.* The area of anti-splitting nail plates shall not be less than 60% of the nominal end area of the tie.

**G. Conditioning.** Ties shall be dried before preservative treatment until the amount of moisture in the wood will not prevent adequate penetration and retention of preservative. The producer may use any of the following methods as long as satisfactory results are obtained.

**1. Air Seasoning.** Ties shall be stacked for air seasoning in accordance with the American Wood Preservers Association (AWPA) Standard C6, Cross Ties and Switch Ties - Preservative Treatment by Pressure Process. Stacking dates during the period of stacking shall be painted on the front of the stack. A maximum of 60 days age spread shall be allowed between the dates of the first ties stacked and the last ties stacked.

Ties shall be stacked as grouped below:

Group Ta	Group Tc	Group Td	
Black Locust	Black Gum	Ash	Hackberry
Black Walnut		Beech	Hard Maples
Honey Locust		Birches	Mulberries
Red Oaks		Catalpa	Sassafras
White Oaks		Cherries	Sycamores
		Elms	White Walnut

**2. Accelerated Seasoning.** Ties may be conditioned by the Boulton drying process, kiln drying, vapor drying or controlled air seasoning in accordance with AWPA Standard C6, Cross ties and Switch Ties - Preservative Treatment by Pressure Process.

**H. Preservative Treatment.** Plants used for the treatment of wood shall conform to AWPA Standard 3, Standard Quality Control Procedures for Wood Preserving Plants.

All cross ties shall be treated with creosote-coal tar solution conforming to AWPA Standard P2, Standard for Creosote and Creosote Solutions, Grade C. Grades A or B may be substituted for Grade C.

Preservative treatment shall be carried out in accordance with AWPA Standard C1, All Timber Products - Preservative Treatment by Pressure Processing or C6, Cross Ties and Switch Ties - Preservative Treatment by Pressure Processes. The method used shall be the empty cell process by use of initial air to control retention.

Retention of preservative shall be 7 pounds of preservative per cubic foot of wood. Retention shall be determined by gauge in accordance with paragraph 3.1 of AWPA Standard C1.

When specified, pentachlorophenol in heavy AWPA Standard P9A solvent may be used as a preservative. Minimum retention shall be 0.4 pounds of preservative per cubic foot of wood.

**INSPECTION AND TESTING.** The Contractor shall give the Materials Bureau thirty days written notice prior to the start of preservative treatment. This notice shall include at the minimum, the name of the tie treater, the location of the treating plant and that date of the initial treatment.

The treating company is responsible for performing quality control in accordance with AWPA M3, Standard Quality Control Procedures for Wood Preserving Plants. All records required to be maintained in accordance with the quality control procedure shall be made available to the Department upon request. A Department representative may be assigned, at the option of the Materials Bureau, to perform sampling and inspection in accordance with Materials Bureau directives and AWPA M2, Standard For Inspection of Treated Timber Products. The producer shall furnish all facilities and equipment for the inspection and testing of the materials and workmanship.

In the event plant inspection is waived, written notice will be provided to the tie treater by the Materials Bureau. The tie treater shall then supply the Materials Bureau with all preservative charge

reports, which describe the treatment process and preservative retention, and written certification that the treatment and ties conform to these specifications.

All treated ties shipped to the project site shall bear in legible form, the inspector's stamp of approval; however, in the event plant inspection has been waived, ties shall be shipped only if they are accompanied by a copy of the Materials Bureau notification waiving plant inspection.

Treated ties shall be subject to final inspection and approval by the Engineer after arrival at the project site.

**SHIPMENT AND STORAGE.** Ties delivered at the job site shall be stacked not less than 10 feet from the nearest rail of any track at suitable and convenient places. They shall not be stacked at public crossing or where they will interfere with the view of trainmen or of people approaching the railroad. Where room for spaced stacking is not available, ties may be piled together provided the lowest layer is at least 6 inches above the ground.

**BASIS OF ACCEPTANCE.** The wood cross ties will be considered for acceptance in stock lot quantities at the treatment facility in accordance with procedural directives of the Materials Bureau.

#### **712-18 THRU 712-23 FOR SITE MANAGER USE**

#### **712-24 PRECAST CONCRETE PERMANENT SURVEY MARKERS**

**SCOPE.** This specification covers the material and quality requirements for precast concrete permanent survey markers.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply. Precast permanent survey markers shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

**FABRICATION.** The Fabrication requirements contained in §704-03 shall apply.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply, except as noted herein. Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 shall apply.

#### **712-99 FOR SITE MANAGER USE**

### **SECTION 713 - LANDSCAPE DEVELOPMENT MATERIALS**

## 713-01 TOPSOIL

**SCOPE.** This specification covers the material requirements for topsoil for use in turf establishment, wildflower seeding, sodding, and planting.

**MATERIAL REQUIREMENTS.** Topsoil may be naturally occurring or may be manufactured. If naturally occurring topsoil exists on the site it shall be the surface layer of soil at a depth specified in the contract documents or approved by the engineer.

Manufactured topsoil is a mixture of materials comprised of a mineral(soil) component that by itself does not exhibit the properties and characteristics of topsoil, an organic material component consisting of compost(s) meeting the requirements of §713-15 *Compost*, and amendment(s), such as limestone meeting the requirements of §713-02 *Limestone* that, when combined together, meet the requirements for topsoil. For manufactured topsoil the contractor shall thoroughly mix the organic portion with the granular portion under dry conditions.

Topsoil shall be free from refuse, material toxic or otherwise deleterious to plant growth, subsoil, sod clumps, seeds or other viable propagules of invasive plants, woody vegetation and stumps, roots, brush, refuse, stones, clay lumps, or similar objects. Construction and demolition debris as classified under 6 NYCRR Part 360, other than uncontaminated land clearing debris, shall not be used to manufacture or amend topsoil. Sod and herbaceous growth such as grass and non-invasive weeds need not be removed but shall be thoroughly broken up and mixed with the soil during handling or manufacturing operations.

**A. Topsoil-Reuse of On-Site Materials.** Existing topsoil stripped and reclaimed in accordance with Section 203 *Excavation and Embankment* taken from sites within the contract limits. The general limits and depth of the material to be utilized for topsoil will be indicated in the Contract documents. Where no depth is indicated it shall be 6 inches. Topsoil shall be stored on site. Based on visual inspection by the Engineer, topsoil may require screening to meet this requirement.

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
2 inch	100
1 inch	85 to 100

### **B. Manufactured or Offsite Materials.**

#### 1. Topsoil -Roadside

- The pH of the material shall be between 5.5 and 7.6.
- The organic content shall be not less than 3% or more than 8%

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
2 inch	100
1 inch	85 to 100
1/4 inch	65 to 100
No. 200	20 to 65
2 Micron	0 to 20

#### 2. Topsoil -Lawn

- The pH of the material shall be between 5.5 and 7.6.
- The organic content shall be not less than 6% or more than 12%

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
1 inch	100
No. 10	90 to 100
No. 40	45 to 80
No. 200	25 to 70
2 Micron	5 to 35

3. Topsoil -Special Planting Mix

-The pH of the material shall be between 5.5 and 7.0.

-The organic content shall be not less than 10% or more than 15%.

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
2 inch	100
1 inch	85 to 100
1/4 inch	65 to 100
No. 200	20 to 40
2 Micron	5 to 35

4. Topsoil - Acidic

-The pH of the material shall be between 4.8 and 6.0.

-The organic content shall be not less than 6% or more than 15%.

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
1 inch	100
No. 10	90 to 100
No. 40	25 to 70
No. 200	5 to 10
2 Micron	5 to 35

**C. Topsoil- Wetland**

1. Topsoil - On-Site Wetland Materials. Existing wetland soil stripped and reclaimed from existing impacted delineated wetlands sites in accordance Section 203 *Excavation and Embankment* taken from within the contract limits and to the depth specified in the contract documents. This wetland soil shall be exempt from the Sampling & Testing requirements.

2. Topsoil - Offsite or Manufactured Wetland Materials. These materials shall meet the following requirements:

The pH of the material shall be between 5.0 and 7.0.

The organic content shall be not less than 15% or more than 20% dry weight basis and be comprised of leaf or well rotted manure compost meeting the requirements of §713-15 *Compost*.

Granular material shall be naturally occurring mineral soil and the following gradation:

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
No. 16	100
No. 40	85 to 100



No. 60	40 to 100
No. 200	5 to 10

The Contractor may amend impacted upland area and manufactured wetland topsoil with approved materials and by approved methods to meet the material requirements.

**STOCKPILING, SAMPLING & TESTING.**

Topsoil-Reuse of On-Site Materials and Topsoil- On-Site Wetland Materials: Topsoil acquired from sites that are designated in the contract documents are not subject to requirements for stockpiling, sampling, and testing.

Topsoil Types Roadside, Lawns & Special Planting Mix, Acidic, and Topsoil - Manufactured or Offsite Wetland Materials are subject to the requirements for stockpiling, sampling and testing.

**Stockpiling.** The details for stockpiling methods and requirements may be obtained from the Landscape Architecture Bureau.

**Sampling.** The details for sampling methods and requirements may be obtained from the Landscape Architecture Bureau.

Samples taken for topsoil amended or manufactured with approved composted biosolids shall be identified as such.

Contractors who believe that an error was made in sampling the topsoil shall, within one work day, indicate the alleged error in writing to the Engineer. The Engineer will respond within 7 calendar days.

**TESTING.**

**Composted Biosolids.** Composted biosolids used to amend or manufacture topsoil shall conform to the applicable requirements of §713-15 *Compost*. Composted biosolids shall require a certificate, from a laboratory approved by the NYS Department of Health, verifying compliance with all applicable laws, rules, and regulations. The certification shall be provided to the Engineer by the Contractor prior to the delivery of any composted biosolids, topsoil containing composted biosolids, or other such regulated material to the contract site. The material shall be approved before it is used.

The Contractor shall have topsoil that has been amended with approved composted biosolids or other such regulated material tested to ensure compliance with the pH organic content, and gradation requirements certified by a nationally recognized entity which provides soils laboratory services and provide the laboratory results to the Engineer.

**Topsoil Testing.** All other material tests required by this section, will be performed by the Department or its designated representative, in conformance with the procedures contained in the appropriate Department publications or test methods. The details for testing methods and requirements may be obtained from the Materials Bureau.

Stockpiles meeting all requirements for pH, organic and gradation may be accepted and used.

Stockpiles that when tested fail to meet requirements for pH or organic may be amended in place. A stockpile that fails to meet gradation requirements may not be accepted. The Contractor shall provide a plan for amending pH and/or organic to the Engineer certified by a nationally recognized entity which provides soils laboratory services. Once the Department accepts the plan and certification the Contractor may amend the stockpile. Re-testing of the stockpile is not required prior to placing the topsoil materials.

**BASIS OF ACCEPTANCE.** Topsoil-Reuse of On-Site Materials and Topsoil- On-Site Wetland Materials will be accepted on the basis of a visual inspection.

Topsoil - Roadside, Topsoil – Lawns, Topsoil - Special Planting Mix, Topsoil - Acidic, and Topsoil - Manufactured or Offsite Wetland Materials will be accepted on the basis of the stockpile meeting all the

requirements or the stockpile material meeting all gradation requirements and a plan and certification approved by Engineer for amending pH and organic requirements.

### **713-02 LIMESTONE**

**SCOPE.** This specification covers the material requirements for limestone.

**MATERIAL REQUIREMENTS.** Limestone shall be ground limestone having a minimum total neutralizing value of 88% calcium carbonate equivalence. A minimum of 90% shall pass the No. 20 sieve and a minimum of 60% shall pass the No. 100 sieve.

**PACKAGING.** Packaged agricultural limestone packed in the manufacturer's standard containers shall weigh not over 100 lbs each, with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container.

**BULK DELIVERY.** Bulk delivery of limestone shall be accompanied by a certificate providing the names, weight and analysis as specified herein for packaged material.

**BASIS OF ACCEPTANCE.** Limestone will be accepted on the basis of the manufacturer's label or certificate and visual inspection for compliance with the material requirements.

### **713-03 FERTILIZER**

**SCOPE.** This specification covers the material requirements for fertilizers.

**MATERIAL REQUIREMENTS.** Fertilizers may be either fluid or dry formulations of commercial carriers of available plant nutrients. Fertilizers may also be provided in standardized packets designed to control the release of their contents over a specified period of time.

The following mixed commercial fertilizers shall contain total nitrogen, phosphoric acid and soluble potash in the ratios stated:

**Type A.** 2-1-1 or 3-1-1 (approximate analysis). Minimum of 50% water insoluble nitrogen and with a salt index of less than 50.

**Type B.** 1-2-1 (approximate analysis) 50 % Organic/IBDU (Isobutydine diurea)/ or coated for slow release with a water in-soluble nitrogen (WIN).

**Type C.** Nitrate of soda containing a minimum of 16% nitrogen or Ammonium sulfate containing a minimum of 20.5% nitrogen as appropriate to soil conditions.

**Type D.** Bonemeal shall be commercial steamed bonemeal, finely ground with a minimum of 1.0% nitrogen and a minimum of 20% phosphoric acid.

**Type E.** 13-0-0 (approximate analysis) shall be a commercial slow release organic nitrogen fertilizer such as blood meal

**PACKAGING.** Packaged fertilizers shall be in the manufacturer's standard containers or packets. Containers shall weigh not more than 100 lbs and shall include a label stating the name of the material, the net weight of the contents, the manufacturer's name, and the guaranteed analysis of the fertilizer. Labels on containers of fluid fertilizers shall state the net volume of the container. Packets shall include a

label stating the name of the material, the net weight of the contents, the manufacturer's name, and the guaranteed analysis of the fertilizer.

**BULK DELIVERY.** Bulk delivery of fertilizer shall be accompanied by the manufacturer's certificate stating the name of the manufacturer, the guaranteed analysis and the weight of the shipment. Certificates accompanying bulk deliveries of fluid fertilizers shall also state the net volume of the shipment.

**BASIS OF ACCEPTANCE.** Fertilizer will be accepted on the basis of the manufacturer's label or certificate indicating conformance with this specification and visual inspection. Material that has become caked or otherwise damaged will be rejected.

### 713-04 SEEDS

**SCOPE.** This specification covers the material requirements for seeds for grasses, legumes, wildflowers and cereals.

**MATERIAL REQUIREMENTS.** All species and their cultivars or varieties must be disease and insect resistant, not considered noxious or invasive, guaranteed hardy and adapted for the locality, and among the top 25% of commercially-available seed types as rated by NTEP (National Turfgrass Evaluation Program). Cultivars infected with non-pathogenic (non-disease causing) fungal endophytes are preferred, if available. Experimental varieties should be excluded.

Material other than pure live seed shall comprise only nonviable seed, chaff, hulls, live seed of crop plants other than those specified, harmless inert matter and non-noxious, non-invasive weed species seeds. Non-noxious, non-invasive species weed seeds will be permitted up to 1% of the gross weight of each seed mixture.

Seeding mixtures shall be composed of perennial (except for annual rye) grasses suited to the site conditions, use, soils, moisture and local climate. All seeds of leguminous plants requiring inoculation shall be inoculated prior to mixing or sowing unless otherwise specified or approved or unless accompanied by a certificate of preinoculation. The Contractor may propose a dormant seed additive for cold weather seeding at no additional cost to the state. The Contractor may propose an alternate range for a component of a given mix based on regional and commercial availability.

#### A. General Roadside Seed Mix

Common Name	Scientific Name	Variety	Percent by weight
Fine Fescue (2 varieties min. must include creeping red)	Festuca rubra var.	Commercial	50-70
Perennial Ryegrass (2 var. min.)	Lolium perenne	Commercial "turf" type	15-40
Annual Ryegrass	Lolium multiflorum	Commercial	5-15
Clover (White preferred)	Trifolium repens	Commercial	5-10

#### B. Restoration/High-Traffic Seed Mix

Common Name	Scientific Name	Variety	Percent by weight
Kentucky Bluegrass (2 var. min.)	Poa pratensis	Commercial	5-20
Fine Fescue (2 var. min.; must include creeping red)	Festuca rubra var.	Commercial	15-40
Tall Fescue (2 var. min.)	Festuca arundinacea	Commercial "turf" type	25-50
Perennial Ryegrass (2 var. min.)	Lolium perenne	Commercial "turf" type	10--30
Annual Ryegrass	Lolium multiflorum	Commercial	5-15

Ticklegrass (or, if unavailable, Redtop)	Agrostis scabra (or Agrostis alba)	Commercial	0-15
Clover (White preferred)	Trifolium repens	Commercial	0-5

**C. Lawn Seed Mix**

Common Name	Scientific Name	Variety	Percent by weight
Kentucky Bluegrass (3 var. min.)	Poa pratensis	Commercial	15-40
Fine Fescue (2 var. min. must include creeping red)	Festuca rubra var.	Commercial	30-50
Perennial Ryegrass (2 var. min.)	Lolium perenne	Commercial “turf” type	15-40
Annual Ryegrass	Lolium multiflorum	Commercial	5-15

**D. Salt-Tolerant Seed Mix**

Common Name	Scientific Name	Variety	Percent by weight
Fine Fescue (must include creeping red and hard fescue)	Festuca rubra var. & Festuca longifolia*	Commercial	10-25
Perennial Ryegrass (2 var. min.)	Lolium perenne	Commercial “turf” type	10-40
Tall Fescue (2 var. min., selected for maximum salt tolerance)	Festuca arundinacea	Commercial “turf” type	25-45
Ticklegrass (or, if unavailable, Redtop)	Agrostis scabra (or Agrostis alba)	Commercial	5-10
Alkaligrass (weeping preferred)	Puccinellia distans	Commercial	15-40

\*aka. F. trachyphylla Krajina; F. brevipila Tracey

**Wildflower Seed Mix.** Wildflower seed mix shall be as specified in contract documents

**Nomenclature.** The common and scientific names of grasses, legumes, wildflowers and cereals specified in the contract documents shall conform to one or more of the authorities on botanical nomenclature recognized by the American Association of Nurserymen.

**Stratification.** Seeds in Wildflower Seed Mixes that require cold and/or warm stratification in order to germinate shall be prepared prior to sowing or used only in fall planting mixes.

**Legume Inoculants.** Legume seeds requiring inoculation shall be accompanied by adequate amounts of their proper inoculants unless accompanied by certification of preinoculation. Inoculants for treating legume seeds shall be a standard culture of nitrogen fixing bacteria that is not more than one year old. Each inoculant shall be the specific culture required for each legume. Inoculants shall be supplied only from suppliers licensed by the Department of Agriculture and Markets to sell legume inoculants in New York State.

**PACKAGING.** Seeds shall be furnished and delivered in labeled containers or bags that are acceptably sealed or sewn tight. All seed and seed labels shall be in accordance with Agriculture and Markets Law. Container or bag labels shall not be removed prior to the time of sowing nor shall container labels be altered, obliterated or otherwise illegible.

When seeds are to be accepted by certification, they may be mixed prior to delivery. The certification shall consist of the label that shall be attached to each container of seed in accordance with the provisions

of the Agriculture and Markets Law. Seeds will not be accepted by certification unless the test dates shown on the seed container labels are within the twelve months prior to the date that the seeds are sown.

Seeds shall be furnished damage free, with no mold, rot or deterioration, as a result of handling, transit or storage. After delivery to the Contractor, seed shall be stored so that it is protected from damage or deterioration from any source.

**BASIS OF ACCEPTANCE.** Seeds will be accepted on the basis of the manufacturer's label or certificate indicating conformance with this specification and Agriculture and Markets Law.

### **713-05 MULCH FOR PLANTING**

**SCOPE.** This specification covers the material requirements for wood and bark chips used as mulch, landscape bedding or erosion control.

**MATERIAL REQUIREMENT.** Wood and bark chips used for mulch, landscape bedding or erosion control may be the following.

**TYPE A Seasoned Wood Chips.** This shall be derived from 100 % first generation hardwood or softwood. The chips shall be seasoned (aged a minimum of 1 year), free from leaves, young growth, unchipped branches, twigs 1 inch or greater in diameter, wood shavings, sawdust or foreign materials such as stones, nails, plastic, etc. Wood chips shall not exceed 3 inches in the greatest dimension.

**TYPE B Recycled or Green Wood Chips.** Shall be wood chips derived from unadulterated construction and/or demolition waste wood. Wood chips derived from construction and/or demolition waste wood shall not be contaminated with paint, chemicals, asphalt shingles, glass, nails, etc. Wood chips shall not exceed 3 inches in the greatest dimension.

**TYPE C USDA-APHIS Protocol Wood Chips.** USDA-APHIS (United States Department of Agriculture- Animal and Plant Health Inspection Service) Protocol wood chips shall be wood chips from current construction activities derived from trees removed and chipped according to USDA-APHIS protocol. Wood is chipped or mulched to less than 1 inch in at least two dimensions or apply an APHIS approved method.

**Type D Shredded Bark Mulch.** Shredded bark mulch shall be commercially available double or triple-processed aged bark mulch made from a mixture of hardwood and/or softwood. It shall be created by regrinding the mulch in a tub grinder and be finely screened to a uniform particle size. It shall be composed of bark and have a low wood content with no hidden woods from construction and demolition debris or pressure treated lumber.

**Type E Pine Bark Chunks or Nuggets.** Pine Bark chunks or nuggets shall be commercially available, manufactured from 100% pine bark and shall not exceed 3 inches.

**BASIS OF ACCEPTANCE.** Wood and bark chips will be accepted on the basis of visual inspection, upon delivery, for compliance with the materials requirements and applicable certification of compliance with 6 NYCRR Part 360.

Shredded bark mulch will be accepted on the basis of a visual inspection for compliance with the material requirements.

### **713-06 TREES, SHRUBS AND VINES**

**SCOPE.** This specification covers the material requirements for trees, shrubs, vines, and other plants

## **MATERIAL REQUIREMENT.**

**Nomenclature.** The common and scientific nomenclature for plants shall be in conformity with the American Nursery and Landscape Association's American Standard for Nursery Stock (ANSI Z60.1).

**Quality and Size.** Plants, including root spread and ball size, shall be in accordance with the American Standard for Nursery Stock (ANSI Z60.1). All plants shall have a normal habit of growth and be typically characteristic of their respective kinds. The specified plant sizes shall be the minimum size allowed and shall include plants from that size up to but not including the next larger size. Plants shall not be pruned at the time of digging or before delivery and no plants shall be cut back from larger sizes to meet the sizes specified. Plants shall be free from injury, insect damage, infestation and disease. Plants except those for transplanting shall be nursery and/or field grown and shall bear evidence of proper nursery care, including adequate transplanting and root pruning. Containers shall be sufficiently rigid to hold the ball shapes and protect the root balls during handling and shipping. Plants shall have been grown in the container long enough for new fibrous roots to have developed so that the root ball is firm and will retain its shape and hold together when removed from the container. The plants shall be in a healthy growing condition with tops which are of good quality, and shall have been adequately hardened off before shipment. The plants shall have been grown in similar climatic conditions to the planting location.

**Digging Plants.** Digging shall avoid all possible injury to, or loss of roots, but when required, roots cut shall be cleanly cut. No cold storage plants will be accepted unless approved in writing prior to delivery. Plants stored temporarily shall be properly heeled in or otherwise protected from injury.

**Root Protection.** After plants are dug, their roots shall be protected from injury such as caused by heat, sun, wind and freezing temperatures.

**Trees.** Pruning cuts on nursery and/or field grown trees shall be healed over. There shall be no cut back crowns or leaders and no abrasions of the bark. Any stem to rootstock grafts shall be healed. Trees must have good fibrous root systems characteristic of the kind. Deciduous trees shall have normal spread of crowns unless otherwise specified. Bare root trees shall not require earth adhering to the roots except as required under Root Protection above.

Balled and burlapped trees shall be properly dug and protected to preserve the natural earth in contact with the roots. No processed balls will be accepted. The balls shall be of the required size, firmly wrapped and tied with approved materials. No balled plants will be acceptable if the ball is cracked or broken.

The tops of trees shall be well formed structurally, but they are not required to have more than reasonably straight trunks, nor better than average well balanced crowns, nor be of specimen or street tree quality consistent with ANSI Z60.1 unless those requirements are specified on the plans

**Shrubs.** Shrubs shall have good fibrous root systems. The quality of balled and burlapped shrubs and container grown shrubs shall be as specified in ANSI Z60.1.

**Vines.** Vines shall be as specified in ANSI Z60.1. Vines shall be field grown unless otherwise specified. Pot grown plants shall be vigorous, well-developed plants, well established in pots with sufficient roots to hold the earth intact after removal from containers but they shall not be rootbound.

**Plants for Transplanting.** Plants, including root spread and ball size, shall be in accordance with ANSI Z60.1 for Collected Plant.

**LABELING.** Labeling shall be in accordance with currently accepted nursery labeling practice except that the Contractor shall upon request supply positive identification by genus and species of any plant.

**TRANSPORTATION.** Tarpaulins or other covers shall be placed over plants transported by open vehicles. Closed vehicles shall be ventilated to avoid overheating and the doors shall be kept closed during shipment to prevent plants from drying. The heads of trees shall be tied-in carefully to prevent fracturing or breaking the branches. Trunks and branches shall be adequately supported and padded to avoid scraping or bruising.

**INSPECTION.** The Contractor shall be responsible to supply current, valid certificates of inspection of plant materials which may be required by federal, state, provincial or other authority to accompany shipments of plants.

The Department will identify by suitable non-injurious means such as painting, marking by various methods, etc. all plant material rejected upon delivery to the contract site.

**BASIS OF ACCEPTANCE:** Acceptance will be based on visual inspection, upon delivery to site, by the Engineer for compliance with the materials requirements.

### **713-07 ROLLED EROSION CONTROL PRODUCTS AND SOIL STABILIZERS**

**SCOPE.** This specification covers the material requirements for Rolled Erosion Control Products and Soil Stabilizers.

#### **MATERIAL REQUIREMENTS**

**Class I (Short-Term)** Light-duty, organic, or synthetic erosion control products.

**Type A.** No minimum shear stress is required. The product shall be capable of withstanding moderate foot traffic without tearing or puncturing.

**Type B.** No minimum shear stress is required.

**Type C.** Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 1.5 psf (pounds force per square foot) at ½ inch soil loss.

**Class II (Intermediate-Term)** Erosion control products.

**Type A. Jute Mesh.** Jute mesh shall be of a uniform, open, plain weave of undyed and unbleached, single-jute yarn. Jute mesh shall be woven as follows:  
Approximately 55 warp ends per yard width.  
Approximately 37 weft ends per linear yard.  
Mass of jute mesh shall average 1.0 (± 5%) pound per square yard.

**Type B.** Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 1 psf at ½ inch soil loss.

**Type C.** Products made entirely of organic materials. Only 100% organic materials are allowed. Products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 1 psf at ½ inch soil loss.

**Type D.** Organic or nonorganic products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 2 psf at ½ inch soil loss.

**Class III (Permanent)** Nondegradable synthetic [fibers, filaments, or nettings] which may be supplemented with degradable natural fiber components).

**Type A.** TRM (Turf Reinforcement Mat) mat products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 2 psf at ½ inch soil loss.

**Type B.** TRM mat products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 3 psf at ½ inch soil loss.

**Type C.** TRM mat (which includes a composite) products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 2.25 psf at ½ inch soil loss.

**Type D.** TRM mat (which includes a composite) products shall have the ability to protect soil from hydraulically induced shear stresses under bench scale conditions for at least 3 psf at ½ inch soil loss.

**Class IV Soil Stabilizers.** Soil stabilizers are short-term duration, erosion control products. When used alone, they shall be used on slopes 1:2 or flatter. They shall not be used in channels or in areas of concentrated flow. Type A, B, and C soil stabilizers may be used alone or in combination with Class III, Types A and B Turf Reinforcement Materials where those products are used on slope applications.

**Type A.** Type A Soil Stabilizer shall be a soil binding system consisting of one of the following:

A Cementitious soil binder which is added to wood cellulose fiber mulch, a Bonded Fiber Matrix (BFM), intended to form a thick, heavy-bodied crust or mat-like barrier that controls storm water and wind induced erosion. BFMs last up to six months and require a cure time up to 48 hours, without rain, to develop intimate soil contact.

A Soil stabilizing polymer which is added to wood cellulose fiber mulch, a Polymer Stabilized Fiber Matrix (PSFM), intended to form a matrix that is designed to work directly with soil to maintain its stability by preserving existing soil structure, flocculating fine sediment being dislodged by storm water or wind, and to prevent splash erosion. PSFMs last up to six months and require a cure time up to 24 hours.

**Type B.** An anionic polyacrylamide (PAM) and calcium solution intended to reduce the erodibility of bare soils during construction activities or to enhance the performance of mulching on permanent slopes. Soil stabilizers, Type B, shall bond soil particles and shall effectively increase the soil particle size to 3/64 inch or larger. Soil stabilizers, Type B, shall reduce the movement of soil due to chemical bonding, thereby increasing the particle size rendering silt fence/sediment trapping devices more effective, and increase the water absorption of the soil.

**Type C.** A soil binder which may be made up of wood fibers, straw fibers, cotton fibers, interlocking fibers, polymers and hydro-colloid tackifiers, a Flexible Growth Medium (FGM) or Cotton Fiber Reinforcement Matrix (C-FRM). Intended to form a thick, heavy-bodied crust or mat-like barrier that controls storm water and wind induced erosion. FGMs/C-FRMs last up to a year and require no cure time to develop intimate soil contact.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer. Upon approval by the Materials Bureau, the product will be placed on the Approved List.



**BASIS OF ACCEPTANCE.** Materials will be accepted on the basis of the manufacturer's name and location appearing on the Approved List and a material certification that specifies the product conforms to this specification.

## **713-08 MATERIALS FOR PROTECTION OF PLANTS**

**SCOPE.** This specification covers the material requirements for materials used in planting and protection of plant operations.

### **MATERIAL REQUIREMENTS**

**Rodent Guards.** Shall be a commercially available horticultural product created for this activity.

#### **Stakes for Supporting Trees**

**A. Above Ground Support.** Shall be wooden stakes, commercially available product or system developed for supporting trees. Wooden stakes shall be 8 to 10 feet long with a minimum diameter of 2 to 2 1/2 inches or stakes 12 feet long which shall have a minimum diameter of 3 inches. The maximum diameter of stakes shall not exceed 4 inches. Stakes shall be pointed at one end. All wooden stakes shall be sound and free from insects and fungi.

**B. Underground Support.** Shall be a commercially available product or system developed for supporting trees.

**Wire.** Wire for guying plants shall be annealed steel wire (either galvanized or ungalvanized).

**Hose.** Hose for protecting the bark from guy wires shall be braided rubber, plastic, or reinforced materials. Hose shall be at least 3/4 inch outside diameter.

**Straps for Protecting Tree Bark.** Straps for protecting tree bark from guy wires shall be stretch resistant nylon or polypropylene fabric. Straps shall be 1 inch wide, shall have soft woven edges to assure abrasion resistance and shall have metal grommets at each end for the purpose of attaching guy wires. Straps shall be of sufficient length to assure guy wires will not be in contact with the tree. Straps for guying trees up to and including 2 inch in diameter shall have a minimum breaking strength of 1,000 lbs. Straps for guying trees up to and including 6 inches in diameter shall have a minimum breaking strength of 4,000 lbs.

**Anti-Desiccants.** Anti-desiccants shall be emulsions or other materials which will provide a protective film over plant surfaces, permeable enough to permit transpiration.

**Portable Drip Irrigation System (PDIS).** PDIS shall allow slow even watering. PDIS shall be a slow release watering system with accommodation for even watering. The fill opening shall accommodate a standard hose diameter. PDIS watering systems shall be constructed so that they can be attached to the trees, provide water from two drip points (minimum) and have a zipper or similar method to attach securely to the tree. PDIS watering system or bags shall be UV treated reinforced Polyethylene material. Each shall be sized according to manufacture's recommendation for plant size and type.

#### **Mowing Markers.**

**A. Type A.** Mowing limit markers shall be any commercially available semi-rigid composite fiber reinforced plastic posts or flexible co-extruded polyethylene posts with U.V. inhibitors. Posts shall

not crack at -20 °F. Posts shall have adhesive decals meeting the following requirements and conforming to the attached details:

Posts or post assemblies shall be such that they can withstand wind and shall be approved by the Engineer.

Approximate Width: 2.5 to 3.inches

Length: 4 feet above ground

Color: Medium to dark brown or black.

Anchor Device: Manufacturer's standard anchor system

Decals shall be brown or black and shall match the color of the posts. Decals shall be cast vinyl sheeting, adhesive on one side, with inks suitable for outdoor use and shall be covered with a laminate protective layer that provides resistance to weather, graffiti, vandalism and discoloration. Letters shall be white and of a size and weight to fully utilize the full dimension of the decal and shall be legible.

**B. Type B.** Mowing limit markers shall be any commercially available glass fiber reinforced polyester stakes, manufactured with UV inhibitors and shall not crack at -22° F. Tubular stakes shall be 3/16 inch (ID), with a 1/16 inch wall thickness, approximately 6 feet in length, and sealed on top with a cap or similar method.

Color shall be olive drab green.

Note: Solid glass fiber stakes which have the same length and color may be substituted with the approval of the Engineer.

**Reflective Tapes.** Material shall be reflective safety tape rated for 5 to 7 years of outdoor life meeting ASTM specifications D4596. Tape shall be 2 inch wide, reflective tape, in red or yellow.

**BASIS OF ACCEPTANCE.** Material for the protection of plants will be accepted on the basis of a visual inspection.

## 713-09 MYCORRHIZAL FUNGI

**SCOPE.** This specification covers the materials requirements for mycorrhizal fungi.

**MATERIAL REQUIREMENTS.** Mycorrhizal fungi shall be commercially available products suited to and labeled for the intended purpose.

Products for turf establishment shall be granular (when mixed directly with soil), or soluble powder or liquid (when mixed with seeds for drill seeding or hydroseeding) and shall typically include:

- Endomycorrhizal fungi. Live propagules (spores, colonized roots, hyphae) of vesicular arbuscular (VA) fungi including *Glomus intraradices* and at least two other *Glomus* species shown to be biologically adapted to grass.

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Products for planting pits, beds and Tree Root Zone Treatment (Vertical Mulching/Aeration) shall typically be granular and shall typically include:

- Endomycorrhizal fungi. Live propagules (spores, colonized roots, hyphae) of vesicular arbuscular (VA) fungi including *Glomus intraradices* and at least two other *Glomus* species.
- Ectomycorrhizal fungi. Live spores of *Pisolithus tinctorius* and at least four *Rhizopogon* species.

Products may also include any or all of:

- Biostimulants such as Dry soluble yucca extract (*yucca schidigera*), soluble sea kelp extract (ascophylum, nodosum) and humic acid (leonardite humates)
- Amino acids, vitamins, enzymes, beneficial bacteria, microbial metabolites, trichoderma fungi.

- Water management gels/polymers (for planting pits, beds and Tree Root Zone Treatment – typically not for turf applications).

**PACKAGING.** Mycorrhizal fungi shall be delivered in the manufacturer’s standard containers. Containers shall include a label stating the name of the material, species, propagule counts, application rates, expiration date, the net weight of the contents, and the manufacturer’s name.

**BASIS OF ACCEPTANCE.** Mycorrhizal fungi will be accepted on the basis of the manufacturer’s label or material certification indicating compliance with these specifications. The Department reserves the right to reject any material that has become caked or otherwise damaged. Material that has expired will be rejected.

### **713-10 MOISTURE RETENTION ADDITIVE**

**SCOPE.** This specification covers the material requirements for moisture retention additive.

**MATERIAL REQUIREMENTS.** Moisture retention additives shall be commercially available Polyacrylamide or Co-polymer of Acrylamide Hydro gel polymer products.

**PACKAGING.** Moisture retention additives shall be delivered in the manufacturer’s standard containers. Containers shall include a label stating the name of the material, application rates, expiration date, the net weight of the contents, and the manufacturer’s name.

**BASIS OF ACCEPTANCE.** Moisture retention additives will be accepted on the basis of the manufacturer’s label or material certification indicating compliance with these specifications.

### **713-11 MULCH FOR TURF ESTABLISHMENT AND EROSION CONTROL**

**SCOPE.** This specification covers the material requirements for organic mulch materials used in conjunction with turf establishment or erosion control.

#### **MATERIAL REQUIREMENTS.**

##### **General**

Mulch shall be manufactured so that the materials will remain uniformly suspended in water under agitation and will blend with seeds, fertilizer and other additives to form homogeneous slurry. It shall have the characteristics which, upon hydraulic application, shall form a blotter-like ground coating with moisture absorption and percolation properties and the ability to cover and hold seeds in contact with the soil. Mulch shall contain no growth or germination inhibiting factors.

**Type I. Wood Fiber Mulch.** Wood fiber shall be a first generation product manufactured directly from 100 percent wood which has been recovered or diverted from solid waste.

Wood fiber shall be manufactured from unadulterated wood that is not contaminated with paint, chemicals, non-wood shingles, plastic or other foreign materials. Wood fiber mulch shall not be manufactured exclusively from paper.

**Type II Cellulose Mulch.** Cellulose or Paper mulch shall be composed of 100% clean recycled cellulose fiber and free of plastic netting.

Water Holding Capacity >1000%

Moisture Content 12% +/- 3

Organic Matter >93%

Ash Content <7%  
pH Range 6.5 +/- 2  
Non toxic dye

**Type III Cellulose and Wood Fiber Blend Mulch.** Cellulose and Wood fiber blend shall be composed of biodegradable recycled 100 % wood fibers and recycled paper, phyto-sanitized and free from plastic netting.

Wood fiber 70% Minimum  
Paper fiber 30% Maximum  
Water Holding Capacity >1000%  
Moisture Content 12% +/- 3  
Organic Matter >93%  
Ash Content <7%  
pH Range 5.5 +/- 2

**Type IV Cotton Hydro Mulch.** Cotton hydro mulch shall be a blend of processed straw and reclaimed cotton plant materials.

Straw 80% Maximum  
Reclaimed Cotton Plant Material 17% Minimum  
Additives, Activators and Tackifiers Range 3 to 10%  
Moisture Content 12% +/- 3  
Organic Matter  $\geq$ 90%

**Type V Pelletized Hydro Mulch.** Cellulose and Wood fiber blend shall be composed of clean cellulose fiber and raw lumber chips manufactured from unadulterated wood that is not contaminated with paint, chemicals, non-wood shingles, plastic or other foreign materials.

Wood fiber 20% Minimum  
Paper fiber 80% Maximum  
Water Holding Capacity >850%  
Moisture Content Range 12 to 15% +/- 3  
Organic Matter >93%  
Ash Content <7%  
pH Range 7.0 +/- 2

**PACKAGING AND LABELING.** Mulch shall be supplied in the manufacturer's standard containers, with the name of the material, net weight of contents, the manufacturer's name and the air dry weight of fiber (equivalent to 10% moisture) appearing on each container.

**STORAGE AND HANDLING.** Store and handle in compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations.

**BASIS OF ACCEPTANCE.** Mulch will be accepted on the basis of the manufacturer's product label, including methods and rates of applications, and material certification indicating compliance with these specifications and any applicable regulatory requirements pertaining to solid waste management.

## **713-12 MULCH ANCHORAGE**

**SCOPE.** This specification covers the material requirements for mulch anchorage.

**MATERIAL REQUIREMENTS.** Mulch anchorage shall be 713-07 Class IV Soil Stabilizers or any non-asphaltic, non-toxic commercially available products formulated for the purpose of anchoring or

tacking straw mulch. The paper content of paper-based hydraulic mulch anchorage shall be 100 percent post consumer recovered from solid waste.

**PACKAGING.** Mulch Anchorage shall be furnished in the manufacturer's standard containers with the name of the material, net weight of contents, the manufacturer's name and the dry weight of fiber (equivalent to 10% moisture) appearing on each container. The instructions for mixing and application shall also appear on each container.

**BASIS OF ACCEPTANCE.** Mulch Anchorage will be accepted on the basis of the manufacturer's product label or product literature that indicates compliance with this specification. Materials that have become wet, caked, frozen, separated or otherwise unfit for use will be rejected.

### **713-13 PESTICIDES**

**SCOPE.** This specification covers the material requirements for pesticides used to manage vegetation, insects, rodents and/or other target pests.

**MATERIAL REQUIREMENTS.** Pesticides shall be approved commercially available products that are currently registered by the US Environmental Protection Agency and the NYS Department of Environmental Conservation. Pesticides shall also have all required labels indicating that they are approved for the intended use.

Pesticides shall be mixed and used in strict conformance with the instructions on the label or supplemental labels.

**PACKAGING.** Pesticides shall be delivered and securely stored until used in the manufacturer's standard containers that have legible labels affixed. Pesticides that do not meet these packaging requirements will be rejected.

Pesticide containers shall be sealed. Containers with breaks, damage; or altered, obliterated, illegible, or missing labels will not be accepted.

**BASIS OF ACCEPTANCE.** Pesticides will be accepted on the basis of the original, sealed, and properly labeled pesticide containers; and two copies of sample labels and supplemental labels that include instructions for the intended use of the pesticide. Pesticides that have become wet, caked or otherwise unfit for use will be rejected.

### **713-14 SOD**

**SCOPE.** This specification covers the material requirements for sod.

**MATERIAL REQUIREMENTS.** Sod shall be commercially grown sod and shall be accompanied by a certificate indicating compliance with the regulations of the NYS Department of Agriculture and Markets.

Sources of sod shall be made known to the Engineer at least five calendar days before cutting. Sod shall be cut into squares or rectangular portions which shall be a minimum of 12 inches wide, or as approved, and may vary in length, but shall be of a size which will permit them to be lifted without breaking. Height of the grass shall not exceed 3 inches. The sod shall be cut to a minimum thickness of 3/4 inch. The sod shall be reasonably free from weeds in conformance with accepted commercial practice. The sod shall consist of a mixture of at least three permanent grasses such as bluegrass and fine leaved fescues, unless otherwise specified. Sod that is heat damaged or fermenting will be rejected.

**DELIVERY AND HANDLING.** Sod shall be delivered to the job within 24 hours after being cut and installed within 48 hours after being cut. The sod, when delivered to the contract site and during the time it is held on site, shall be sufficiently moist so the soil will adhere firmly to the roots when it is handled.

**BASIS OF ACCEPTANCE.** Sod will be accepted based on inspection for compliance with the material requirements.

### 713-15 COMPOST

**SCOPE.** This specification covers the material requirements for organic material used in conjunction with amending or manufacturing topsoil and for erosion control products.

**MATERIAL REQUIREMENTS.** Compost shall be the material resulting from the biological and biochemical decomposition of biosolids, source-separated organic waste, yard waste, leaves or agricultural waste. These composts shall have been commercially or municipally produced. Compost and composting facilities shall be in compliance with all federal laws (40 CFR Part 503 and others), Article 10 of the Agriculture and Markets Law and 6 NYCRR Part 360.

Biosolids, including mixed solid waste, septage and other sludges, are the solid or semi-solid organic material generated by a wastewater treatment plant. Source-separated organic waste (SSOW) is readily decomposable material that is separated at the point of waste generation, and may include, but not be limited to, food scraps, food processing residues, soiled and/or unrecyclable paper, and other compostable materials. Yard waste includes grass clippings, leaves and other similar readily-compostable organic material.

Compost shall be reasonably free of sticks, stones, refuse, materials deleterious to soil structure, or any material toxic or detrimental to plant germination and growth. Compost containing foreign material may be rejected on the basis of a visual examination.

Composted biosolids shall have a certificate from a laboratory approved by the NYSDOH verifying compliance with all applicable laws, rules, and regulations. Only facilities permitted to compost biosolids under 6 NYCRR Part 360 will be allowed to furnish biosolid compost. The certification shall be supplied by the Contractor prior to the delivery of any composted biosolids, topsoil containing composted biosolids, or other such regulated material to the contract site.

**Type A. Compost for Turf Establishment, Sodding, and Planting.** Compost for Turf Establishment, Sodding, and Planting shall have a minimum organic-matter content of 30% (dry-weight basis) as determined by loss on ignition.

Product shall be loose and friable, not dusty, and have a moisture content of 35% - 60%, (wet weight basis).

Particle size shall be < 1/2 inch, (100% passing).

Soluble salts concentration shall be < 4.0 mmhos/cm (ds/m), maximum.

Compost shall be stable to very stable.

pH shall be between 6.0-8.5.

**Type B. Compost for Erosion/Sediment Control Filter Berms.** Compost for Erosion/Sediment Control Filter Berms shall meet the requirements of AASHTO Designation MP 9-03 and as follows:

Minimum organic matter content 25% - 65% (dry-weight basis) surfaces to be vegetated; 25% - 100% (dry weight basis) surfaces to be left unvegetated.

<b>Gradation:</b>
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Sieve Size	Percent Passing by Weight
3 inch	100
1 inch	90 to 100
3/4 inch	70 to 100
1/4 inch	30 to 75
Maximum particle length; 6 inch	

Soluble salt concentration shall be 5 mmhos/cm; (ds/m) maximum.  
 Compost shall be stable to very stable  
 pH shall be between 5.0 - 8.5.

**Type C. Compost for Erosion/Sediment Control Compost Blankets (Mulch for Seeded Areas).**

Compost for Erosion/Sediment Control Compost Blankets, (mulch for seeded areas), shall meet the requirements of AASHTO Designation MP 10-03 and as follows:

For surfaces to be vegetated, minimum organic matter content 25% - 65% (dry weight basis); for surfaces to be left unvegetated 25% - 100% (dry-weight basis).

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
3 inch	100
1 inch	90 to 100
3/4 inch	65 to 100
1/4 inch	0 to 75
Maximum particle length; 6 inch	

Soluble salt concentration shall be 5 mmhos/cm; (ds/m) maximum.  
 Compost shall be stable to very stable.  
 pH shall be between 5.0 - 8.5.

**Type D. Leaf Compost.** The material shall consist exclusively of deciduous leaf material. Compost material that contains food waste, sewage waste, or other waste material is unacceptable. The leaf compost shall be mature (actively composted for 6 months minimum, and temperature slightly above air temperature) and humic (organic material is no longer rapidly degrading). Mature compost material shall be a dark, friable, partially decomposed substance that has an earthy odor. Visible fibers should be short and dark with no discernable particles of leaf material. Because not all items decompose at the same rate screening may be necessary to remove larger partially decomposed material and/or undecomposed material.

- Organic Content – 25% to 100% by dry weight
- Natural Inert Material - <5% by dry weight of woody or green yard debris material.
- Man Made Inert Material - <1% by dry weight of man made material such as glass or plastic.
- Bulk Density – 636 to 812 kg/m<sup>3</sup>
- Moisture Content – 30% to 60% by total weight

<b>Gradation:</b>	
Sieve Size	Percent Passing by Weight
1/2 inch	100
No 16	0
Maximum particle length; 6 inch	

**Type E. Well Rotted Manure.** The material shall consist of animal excreta with litter material. The well rotted manure shall be mature (aged a minimum of one year), dark brown or black in color, crumbly in texture, and shall not have an objectionable odor. The material's moisture content shall be such that no visible free water or dust is produced when handling it. It shall contain no visible admixture of refuse or other physical contaminants or any material toxic to plant growth.

**BASIS OF ACCEPTANCE.** Compost will be accepted on the basis of a Producer's label or a certificate of analysis by a laboratory certified by a nationally recognized entity indicating compliance with the material requirements and visual inspection.

Composted biosolids will be accepted on the basis of a material certification by a NYSDOH approved laboratory that the product conforms to this specification and all applicable regulations.

Compost supplied or manufactured by participants in the US Composting Council's Seal of Testing Approval Program will be accepted on the basis of the Program's Compost Technical Data Sheets. The data shall represent a minimum of one year of testing results and the most recent test shall have been conducted with ninety days of material acceptance.

Compost supplied or manufactured by suppliers that do not participate in the US Composting Council Seal of Testing Approval Program will be accepted on the basis of a material certification, by a laboratory certified by a nationally recognized entity, that the product conforms to this specification.

The Department reserves the right to sample and test the materials subsequent to delivery.

#### **713-16 (VACANT)**

#### **713-17 SULFUR**

**SCOPE.** This specification covers the material requirements for elemental sulfur (flowers of sulfur).

#### **MATERIAL REQUIREMENTS.**

**PACKAGING.** Agricultural sulfur packed in the manufacturer's standard containers shall weigh not over 100 lbs each, with the name of the material, net weight of contents and the manufacturer's name and guaranteed analysis appearing on each container. Sulfur shall be commercially available products.

**DELIVERY.** Bulk delivery of sulfur shall be accompanied by a certificate providing the names, weight and analysis as specified herein for packaged material.

**BASIS OF ACCEPTANCE.** Sulfur will be accepted on the basis of the manufacturer's label or certificate and visual inspection for compliance with the material requirements.

#### **713-18 WEED CONTROL BARRIERS**

**SCOPE.** This specification covers the material requirements for landscape fabrics, mats and Geotextiles specifically manufactured to control weed growth.

**MATERIAL REQUIREMENTS.** Weed control barriers shall be commercially available products.

**Type A. Permeable Landscape Fabric.** Permeable Landscape Fabric shall be a permeable weed blocking geotextile resistant to rot, mold, chemicals and micro-organisms which allows the free flow of water, air, fertilizers and nutrients.



**Type B. Permeable Landscape Fabric with Herbicide.** Permeable Landscape Fabric with Herbicide shall be durable, nonwoven, polypropylene geotextile fabric with permanently attached nodules containing a slow release herbicide with a maximum EPA toxicity rating of class IV.

**Type C. Permeable Weed Barrier Mat.** Permeable Weed Barrier Mat shall be a commercial weed control product. The mat shall prevent sunlight, water, or vegetation nutrients from reaching the soil underneath. The mat shall contain no herbicides and shall resist ultraviolet light, mildew, and algae.

The mat shall be self-extinguishing when removed from flame.

The mat shall be a polyester matting system a minimum of 0.2 inches thick, with a minimum weight of 1.8 pounds per square yard, able to support pedestrian traffic and commercial tractor mowing equipment's wheels and skid plates without displacement.

**BASIS OF ACCEPTANCE.** Weed control mats or fabric will be accepted on the basis of the manufacturer's label or certificate and visual inspection for compliance with the material requirements.

### 713-19 STRAW

**SCOPE.** This specification covers the materials requirements for straw.

**MATERIAL REQUIREMENTS.** Straw for mulching shall be stalks of oats, wheat, rye or other similar crops which are free from noxious and invasive species. Straw shall show no signs of excessive moisture and be visually free of mold or mildew

**BASIS OF ACCEPTANCE.** Straw will be accepted on the basis of a visual inspection for compliance with the material requirements.

### 713-20 SEDIMENT FILTER LOGS

**SCOPE.** This specification covers the material requirements for sediment filter logs.

**MATERIAL REQUIREMENTS.** Sediment filter logs shall meet the following material requirements:

- Be capable of filtering sediment.
- Consist of a fill material encased in a mesh tube of netting.
  - Both fill and netting material shall be bio- or photo- degradable with a minimum functional longevity of one (1) year.
  - Filling shall be made of wood, straw, coconut fibers or other natural materials.
- Be weed and seed free.
- Have an effective height that is a minimum of 75% of the specified log diameter.
- Be capable of being installed without trenching and still function properly.
- Be movable once placed to accommodate field adjustments.

**BASIS OF APPROVAL.** The Manufacturer shall submit an application for approval to the Materials Bureau, along with a minimum of one foot of assembled product sample and product literature. Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Materials will be accepted on the basis of the manufacturer's name and location appearing on the Approved List and a material certification that specifies the product conforms to this specification.

## 713-99 FOR SITE MANAGER USE

### SECTION 714 - CURBING AND GUTTER

#### 714-01 STONE CURB

**SCOPE.** This specification covers the material and fabrication requirements for stone curb used in highway and bridge construction.

**MATERIAL REQUIREMENTS.** Stone curb shall be sound and durable, free from seams which impair its structural integrity and of a smooth splitting and machining character. Natural color variations that are characteristic of the deposit will be permitted. Any curb containing discoloration other than cleanable surface stains shall be sampled and submitted to the Materials Bureau for evaluation.

**Color.** The color of curb sections shall be consistent with adjacent curb sections already in place, and consistent with each other. If no reference is available or specified in the contract documents the color shall be gray.

#### Dimensions

**A. General.** Curb shall be cut to conform to the shape and size shown on the Standard Sheets and contract plans.

**B. Curbs on Straight Sections.** Minimum lengths of straight segments of Light Duty, and Sloped curbs shall be 2 feet. All other straight curb types shall have 3-foot minimum lengths.

**C. Curbs on Curved Sections.** For curves with a radius of 175 feet or more, the curb lengths shall conform to the above guidance on Straight Sections. Curb segments on curves with radii of 175 to 100 feet shall be cut in straight 3- to 5-foot lengths or, preferably, for radii closer to 100 feet, shaped pieces of 3 to 7 feet in length.

Except for Light Duty and Sloped curbs, segments on curves with a radius of less than 100 feet shall be shaped to the required curvature and the ends cut radially to length.

<u>Radius (ft)</u>	<u>Allowable Segment Length Range (ft)</u>
100 – 10	3 – 7 (shorter lengths permitted for closure pieces)
< 10	2 - 4

For Light Duty and Sloped curbs on curves, the curb may be furnished in straight lengths where the following radius and length limits apply.

<u>Radius (ft)</u>	<u>Allowable Segment Length Range (ft)</u>
100 – 50	2 – 4
50 – 10	1.5 – 3
< 10	1 - 2

For lengths under 100 feet, Light Duty curb shall be radially cut on the ends. For lengths under 100 feet, the ends of Sloped curb shall be radially cut relative to its final inclined orientation.

**D. Transition Curb for Bridge to Roadway Curbs.** A transition curb for bridge curb to roadway curb shall be furnished, if required. Where an 8-inch exposed face is desired for a roadway curb, the appropriate curb sections with a 6-inch exposed face shown on the appropriate section of the Standard Sheet shall be increased 2 inches in depth.

**E. Curb Widths.** The bottom width tolerances of the various types of curbing shall be as follows:

Type	Bottom Width
Light Duty (LD)	Down to 3 inches for maximum 1/4 of length
Near Vertical Face (NVF), Lean Back (LB) Option 2, and Mountable (MT)	Down to 4 inches for maximum 1/4 of length
Lean Back (LB) Option 1, Radius	Down to 5 inches for maximum 1/4 of length
Traversable (TR)	Down to 10 inches for maximum 1/4 of length

## Finish

**A. General.** Curb surfaces shall be finished as indicated on the plans or Standard Sheets.

**B. Top Surfaces.** Top surfaces shall be finished to approximately true planes. When sawed, hammered or thermal finishes are applied, no projection or depression shall be greater than 3/16 inch. Saw marks normal to the sawing process will be permitted if within the 3/16-inch tolerance.

**C. Arris Lines.** Top front arris lines shall be straight and true with no variations greater than 1/8 inch measured with a 2-foot straight edge placed along the arris line.

Back arris line on curb type F1 curb and the lower front arris line on type F1 curb shall be straight and true with no variations from a straight line greater than 1/4 inch measured in the same manner.

Exposed arris lines at the joints shall not project beyond the plane of a split face and shall not fall under the plane of a split face more than 1/4 inch.

**D. Back Surfaces** Back surfaces, when tilted to vertical, shall have no projection or depression in the top three inches which exceeds a batter of 1 inch in 3 inches

**E. Front Exposed Faces.** Front exposed faces of straight Type, Mountable and F1curbs, when split, shall have no projection greater than 1 inch or depression greater than 1/2 inch measured from a vertical plane passing through the arris line at the top of the split face. For radius units, the front exposed faces, when split, shall have no projection greater than 1 1/4 inch. Front faces below grade shall have no depression greater than 1 inch measured in the same manner.

**F. Ends.** Ends of straight curbs shall be approximately square with the planes of the exposed curb surfaces and all curbs shall be finished so that when curbs are set, no space greater than 3/4 inch shall show in the joints for the full length of the exposed joint. The curb ends below the pavement surface or shoulder shall break not over 8 inches from the joint plane on curb types Near Vertical Face and Mountable curbs.

Ends of type F1 curb shall be sawed at locations called for on the contract plans.

**G. Drill Holes.** Drill holes shall not be permitted in exposed curb surfaces.

## Exceptions to Finish Requirements

**A. Sloped Type Curb.** Exposed faces shall be relatively smooth and quarry split to an approximately true plane having no projection or depression greater than 1 inch from a 2-foot straightedge placed as closely as possible to the plane of the curb face.

Arris lines at joints shall not project beyond the plane of the split face and shall not fall more than 1/2 inch under the plane of the split face.

Curb ends shall be approximately square with the plane of the exposed curb surfaces and finished so that when curbs are set, no space greater than 3/4 inch shall show in the joints for the full width of the face.

**B. Light Duty Type Curbs.** Front arris lines shall not vary from a straight line more than 1/2 inch. Exposed joint openings shall not exceed 1 1/2 inch.

**BASIS OF APPROVAL.** Dimension stone curb sources are approved based on testing and a favorable geologic evaluation of the stone quarry. The stone shall be sound and durable, and contain no fractures, cracks, or seams which impair its structural integrity. The stone shall be of a smooth splitting and machining character. Natural color variations that are characteristic of the deposit will be permitted. Approval is maintained by routine testing, demonstrating the capacity to supply highway and bridge curb, and maintaining a current company contact and color sample, to the satisfaction of the Director of the Materials Engineering Bureau.

**BASIS OF ACCEPTANCE.** Stone curb shall be from a source appearing on the Department's Approved List and will be inspected for dimensional, color, and quality compliance at the project site by the Engineer. Curbing not in compliance with the contract specified color, or dimensions on the Standard Sheets or contract plans will be rejected by the Engineer.

#### **714-02 AND 714-03 (VACANT)**

#### **714-04 PRECAST CONCRETE CURB**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete curb.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply. Precast curb shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

Minimum curb lengths shall be 6 feet except for radial curb and closures. Maximum curb lengths shall be 10 feet. Curb to be set on a radius of 100 feet or less shall be cast to the curve required and the ends shall be formed or sawed on radial lines. Curbs to be set on a radius of 101 to 200 feet may be cast or cut in 3 or 4 foot straight lengths, if approved by the Engineer.

**Reinforcing.** Reinforcement is optional, however if the manufacturer chooses to reinforce the curb for handling the reinforcement shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on an end face of each unit such that they won't be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

**714-05 (VACANT)**

**714-06 (VACANT)**

### **714-07 PRECAST CONCRETE GUTTER**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete gutter.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply.

Precast concrete gutter shall be fabricated to conform to the size and shape shown on the standard sheet unless otherwise shown on the plans.

**Reinforcing.** Wire mesh reinforcement shall consist of one layer of Size 4 x 4 inch - W4 x W4 embedded midway between the upper and lower surfaces, unless otherwise shown on the plans. Reinforcing bars of equivalent area may be substituted for the wire mesh reinforcement. Reinforcement shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on an end face of each unit such that they won't be exposed to view after installation. Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply.

**714-99 FOR SITE MANAGER USE**

## **SECTION 715 - CASTINGS, FORGINGS AND METALS**

(Last Revised January, 2017)

**715-01 STRUCTURAL STEEL**

**SCOPE.** This specification covers structural steels used in bridge construction that have a minimum specified yield point of 70 ksi, or less. Steel ordered under this specification may be subject to stress in any direction.

**MATERIAL REQUIREMENTS.** The manufacture, testing, mill inspection and delivery of structural steel shall comply with the requirements of the applicable ASTM Specifications except as modified herein.

Requirements for shop inspection of plates and shapes, and provisions for rejection or shop repair of plates and shapes because of rejectable surface or internal discontinuities, are described in the New York State Steel Construction Manual (SCM).

**Steels to be Furnished.** The contract documents will indicate, by ASTM designation, the steel to be used in specific portions of the structure. If the ASTM designation is not indicated in the contract documents, the type to be furnished shall meet the requirements of ASTM A709 -50.

All structural steel plates and shapes used in areas subject to tensile stress as designated in the contract documents, or as listed herein, shall meet the minimum Charpy V-Notch toughness requirements. The Contractor shall submit an RFI to the DCES in the event of uncertainty as to the state of stress in a component. The following Structural Steel shall meet the minimum notch toughness requirements:

- Tension flanges and webs of girders, floorbeams and stringers, floorbeam and stringer connection angles, splice plates and lateral gusset plates welded to members in areas subject to tensile stress.
- Curved girder diaphragms
- Truss chords and diagonals, floorbeam and stringer connection angles, cantilever brackets, splice plates, and vertical gusset plates.
- Components used to repair or reinforce existing steel if the components are subjected to tensile stress.
- Plates and shapes of specified thickness which are subject to design tensile stress used in overhead sign structures in accordance with §644-2.01.

**TESTS.** Physical (mechanical) tests and chemical analysis shall be conducted in accordance with the applicable ASTM designation, except as modified herein.

**Charpy V-Notch (CVN) Testing.** Material sampling shall be performed in accordance with ASTM A673 *Standard Specification for Sampling Procedure for Impact Testing of Structural Steel*. Testing methodology and reporting will be in accordance with ASTM A370 *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*. Minimum energy values and testing frequency shall be based on whether the components are fracture-critical or not. For material that is required to be shop inspected, Mill Test Reports (MTRs) shall be provided to the shop inspector, for forwarding to the DCES. For material that is not required to be shop inspected, Mill Test Reports (MTRs) shall be provided to the Engineer.

**Fracture-Critical Members (FCM).** Testing frequency and CVN toughness values will be provided in accordance with the requirements of Section 904 of the SCM. If the ASTM material specification for Temperature Zone 2 has a toughness requirement that differs from the SCM minimums, then the higher value will govern.

**Non-FCM Material.** The minimum toughness values will be in accordance with the ASTM specification for the given material, Temperature Zone 2. Testing shall be at the “H” frequency. For steels where the CVN toughness is not specified in ASTM, minimum CVN values will depend on yield stress, High Performance designation and plate thickness, as shown in Table 715-01-1

<b>Table 715-01-1 Charpy V-Notch Impact Requirements</b>		
<b>Yield Stress (ksi)/ Performance Designation</b>	<b>Plate thickness (in.)</b>	<b>Min Energy (ft-lbs)</b>
below 50	any	15 @ 40°F
50	To 2 incl.	15 @ 40°F
50	Over 2 to 4	20 @ 40°F
HPS 50	To 4 incl.	20 @ 10°F
HPS 70	To 4 incl.	25 @ -10°F

**Basis of Acceptance.** Materials that are shop inspected by the Department will be accepted on the basis of conformance with the material requirements and traceability criteria in accordance with Section 508 of the SCM. Materials that are not shop inspected will be accepted on the basis of acceptable Mill Test Reports and a visual inspection by the Engineer. *Buy America requirements apply.*

## **715-02 STEEL CASTINGS**

**SCOPE.** This specification covers the material requirements for steel casting for highway bridges.

**GENERAL.** Steel castings shall conform to the requirements of ASTM A27. Unless otherwise specified, all steel castings shall be Grade 70-40, Class 1.

### **MATERIAL REQUIREMENTS**

**Fracture.** Test specimens shall show a fracture having a silky or fine granular structure throughout.

**Testing.** Additional supplemental testing, as noted in ASTM A27, may be required by the contract documents.

**Structural Defects.** Steel castings shall be true to pattern in form and dimensions, without sharp unfilled angles, or corners, and shall be free of pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

Blow holes appearing upon finished castings shall be so located that a straight line laid in any direction will not cut a total length of cavity greater than 1 inch in any 12 inches, nor shall any single blow hole exceed 1 inch in any dimension or have an area greater than 1/2 square inch. Blow holes shall not have a depth injuriously affecting the strength of the casting as determined by the Deputy Chief Engineer (Structures). Minor defects which do not impair the strength may, with the approval of the Deputy Chief Engineer (Structures), be welded by an approved process. The defects shall be removed to solid metal by drilling, grinding, or air-carbon arc gouging followed by grinding. After welding, the castings shall be heat treated again if required by the approved repair procedure.

Castings which have been, or are being, welded without prior approval of the repair welding procedure will be rejected.

Large castings may be subjected to non-destructive tests if required by the Contract Documents.

**BASIS OF ACCEPTANCE.** Acceptance will be based upon shop inspection at the manufacturing plant by representatives of the Department, or on the basis of inspection by the Engineer. Certified copies of the results of the chemical and physical tests shall be submitted as required under the provisions of “Basis of Acceptance” in 715-01, Structural Steel. *Buy America Requirements Apply.*

## 715-03 ALUMINUM CASTINGS

**SCOPE.** This specification covers the requirements for various aluminum alloys and shapes.

**GENERAL.** Aluminum castings shall conform to the requirements of ASTM Specifications as shown in the following table, and as modified herein and by the plans and specifications.

<b>TABLE 715-03 ALUMINUM CASTINGS</b>			
<b>Commercial Specification Alloy &amp; Temper</b>	<b>ASTM Alloy &amp; Temper</b>	<b>ASTM Specification</b>	<b>Product</b>
B443.0-F	S5A-F	B108	Permanent Mold Castings
B443.0-F	S5A-F	B26	Sand Castings
A356.0(modified) <sup>1</sup>	SG 70-B(modified) <sup>1</sup>	B108	Permanent Mold Castings
356.0-T6	SG 70A-T6	B26	Sand Castings
356.0-F	SG 70A-F	B26	Sand Castings
360.0	SG 100-B	B85	Die Castings
A712.0	ZG 61-B	B26	Sand Castings

**NOTE:** 1. Where this material is required, castings shall be solution treated and aged to produce the following mechanical properties (Yield strength need not be determined unless ordered by the Deputy Chief Engineer (Technical Services)):

Ultimate Tensile Strength	25 ksi min.
Yield Strength (0.2 percent offset)	18 ksi min.
Elongation (measured with gage length of four times the diameter of the specimen.)	6 percent min.

### MATERIAL REQUIREMENTS

**Quality.** The castings shall be of uniform quality and condition, free from cracks, blow holes, porous places, hard spots, or shrinkage defects which affect the suitability of the castings for their intended use. Before inspection the castings shall be smooth and clean.

**Heat Treatment.** Casting shall be heat treated in such a manner as to produce material which will conform to the properties specified herein with the approved uniformity.

Castings to be used as bridge railing posts shall be produced under radiographic control. This shall consist of radiographic examination of castings until proper foundry technique, which will produce castings consistently free from harmful internal defects, is established for each mold. Production castings shall be examined as necessary to ensure maintenance of satisfactory quality.

Tension test specimens shall be machined from integrally cast test coupons extending sufficiently from one side of the base of the posts to obtain a 0.35 inch diameter test specimen as defined in "Methods of Tension Testing of Metallic Materials" ASTM E8, with the exception that the radii at the ends of the reduced section shall not be less than 1/2 inch.

The method of test and determination of tensile properties shall be in accordance with ASTM E8. A minimum of one percent of the posts in any lot, but not less than one, shall be sampled for tensile testing. For the purpose of sampling, a lot shall consist of not more than 1000 pounds of clean castings when produced from a batch type furnace charged with one heat of ingot of known analysis or not more than 1 ton of clean castings when produced from one continuous furnace in not more than 8 consecutive hours.



If the results of any tensile test do not conform to the requirements prescribed, two additional tests shall be taken from the same group of castings, and the average of the three tests must meet the requirements.

**BASIS OF ACCEPTANCE.** This material is accepted on the basis of a Material Certification as described in “Basis of Acceptance,” 715-01 except as follows, when the material is used in:

**Bridge Railings.** Accepted on the basis of shop inspection by the Department in accordance with Department directives.

**Fencing.** Accepted on the basis of samples secured in accordance with Department directives.

**715-04 WROUGHT ALUMINUM**

**SCOPE.** This specification covers the requirements for various aluminum alloys and shapes.

**MATERIAL REQUIREMENTS**

**Physical & Chemical Requirements.** Wrought aluminum shall conform to the requirements of ASTM specifications as shown in Table 715-04 and as modified herein and by the plans and specifications.

Each piece shall be marked with the manufacturer's name or trade mark and with alloy and temper designations in the manner described in the pertinent ASTM specifications.

When a clad material is specified, it shall be clad on both sides unless specified otherwise.

**Mechanical Properties.** When alloy 6061-T94 is required by the plans or specifications, it shall be defined as that temper which will produce in the wire the following mechanical properties after weaving:

- minimum ultimate tensile strength: 54 ksi
- minimum tensile yield strength: 47 ksi

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of a Material Certification except when this material is used in Bridge Railing when it will be accepted on the basis of shop inspection by the Department in accordance with Department directives, or Fencing when it will be accepted on the basis of samples received in accordance with Departmental directives.

<b>TABLE 715-04 PHYSICAL AND CHEMICAL REQUIREMENTS</b>		
<b>PRODUCT</b>	<b>ALLOY &amp; TEMPERS</b>	<b>ASTM SPEC.</b>
Sheet and Plate	1100-0	B209
	2024-T4	B209
	3003-H14	B209
	3004-H38	B209
	5052-H32,-H38	B209
	5154-H38	B209
	6061-T6	B209
	7075-T6	B209
	ALCLAD 2024-T3,-T42	B209
	ALCLAD 6061-T6	B209
Wire	1100-H38	B211
	3003-H14	B211
	5052-H38	B211
	6061-T94 <sup>1</sup>	B211

Bars and Rod	2024-T4 6061-T6	B211 B211
Extruded Bars and Rods and Shapes	5154-O 6061-T6 6063-T5	B221 B221 B221
Extruded Shapes	6063-T6 6005-T5 6351-T6	B211 B211 B211
Drawn Seamless Tube	6061-T6 6063-T832	B210 B210
Extruded Tube	6061-T6	B241
Pipe	6061-T6 6063-T6	B241 B241
Structural Shapes, Rolled or Extruded	6061-T6	B308
Welding Rods and Bare Electrodes	4043-O 5154-O	Not ASTM <sup>2</sup> Not ASTM <sup>2</sup>

**NOTES:** 1. See Mechanical Properties.  
2. Available from American Welding Society.

## 715-05 IRON CASTINGS

**SCOPE.** This specification covers material requirements for iron castings.

**MATERIAL REQUIREMENTS.** Iron castings shall conform to the requirements of AASHTO M 105, Class 30B or Class 35B, or ASTM A48, Class 30.

**FABRICATION.** Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects at locations affecting their strength and value for the service intended. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. Castings having blow holes plugged or filled with putty or cement of any kind will be rejected.

Grates, covers and curb boxes shall have continuous, full, and uniform bearing contact with their corresponding frames and shall be non-rocking when in place and under the influence of traffic or other loads. Methods that are permissible to achieve secure non-rocking fit between grates, covers and their corresponding frames are:

- Ground mating surfaces
- Machined and milled mating surfaces (horizontal and/or vertical).

All cast gratings, covers, frames and curb boxes shall be free of any coatings unless specified otherwise.

**BASIS OF ACCEPTANCE.** Iron castings conforming to the requirements of Standard Sheets “Cast Manhole Frames, Grates and Covers” and “Cast Frames and Curb Boxes and Welded Frames” will be accepted in accordance with the procedural directives of the Department. *Buy America Requirements Apply.*

## 715-06 STEEL FORGINGS

**MATERIAL REQUIREMENTS.** Steel forgings shall conform to the requirements of ASTM A668 Class C (CH), F (FH), or other class approved by the DCES.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be in accordance with procedural directives of the Department. *Buy America Requirements Apply.*

## **715-07 PROOF LOADED IRON CASTINGS**

**SCOPE.** This specification covers material and testing requirements for proof loaded iron castings.

**MATERIAL REQUIREMENTS.** Iron castings shall conform to the requirements of AASHTO M306, except for gray iron may be class 30B or class 35B and ductile iron shall have a minimum yield strength of 50 ksi. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects at locations affecting their strength and value for the service intended, and shall not be galvanized.

Grates, covers and curb boxes shall have continuous, full, and uniform bearing contact with their corresponding frames and shall be non-rocking when in place and under the influence of traffic or other loads. Methods that are permissible to achieve secure non-rocking fit between grates, covers and their corresponding frames are:

- Ground mating surfaces
- Machined and milled mating surfaces (horizontal and/or vertical).

All gratings, covers, frames and curb boxes shall be free of any coatings unless specified otherwise. Castings shall be boldly filleted at angles, and the arrises shall be sharp and perfect. Castings having blow-holes plugged or filled with putty or cement of any kind will be rejected.

**Materials Details.** All dimensions, including specified tolerances, in the Material Details shall substantially comply with the dimensions specified on the relevant standard sheets. The class of gray iron and yield strength of ductile iron shall be clearly identified on the drawings.

**Testing Facility.** The Department will conduct the proof load testing for acceptance of the design.

**SAMPLES AND SUBMISSIONS.** The manufacturer/supplier shall provide the following to the Materials Bureau before any testing can begin:

- Two (2) copies of the Material Details for each iron casting to be approved
- Two (2) samples of each cast article to be load tested
- One (1) sample of corresponding approved frame, grate, or cover, and any nuts and bolts required for assembly
- Two (2) tension test specimens cast within an hour of casting each of the test samples and machined as per AASHTO M 105 Type B.

It is the manufacturer/supplier=s responsibility to remove in an expedient manner all supplied material from the Department=s premises after the tests are done.

**Failure Criteria.** The design of an iron casting will be rejected if the following conditions are not met:

**A. Permanent Set.** This criterion applies to cast iron grate and cover. The maximum permanent set in any article, measured relative to a fixed horizontal plane, shall not exceed the lesser of 1/8 inch or 1/150 of the clear opening.

**B. Cracks.** All articles will be inspected after the completion of each test. No part of any article shall break or have any cracks.

**Retests and Re-submissions.** If the dimensions of the article(s) do not comply with the dimensions given in the Material Details, either new article(s) or new Details shall be submitted at the manufacturer's option. Upon failure under proof loading no retests will be allowed. Complete new designs shall be submitted for further testing.

**BASIS OF APPROVAL.** Material Details shall be prepared and submitted to the Director of Materials Bureau for approval. The articles will be proof-load tested in accordance to the Department's Test Method "Proof Loading of Cast Iron Frames, Grates, Covers and Curb Boxes", a copy of which may be obtained from the Director of Materials Bureau. After the proof-load tests are successful and the drawings are approved, the manufacturer's name, Material Details and approval date will be placed on the Department's Approved List.

**BASIS OF ACCEPTANCE.** Cast iron frames, grates, covers and curb boxes will be accepted at the project site based on the manufacturer's name appearing on the Approved List, conformance to the approved Material Details, and a Material Certification. *Buy America Requirements Apply.*

For each type of casting supplied, the following shall be provided to the Engineer:

**A. Material Certification.** The manufacturer or supplier shall provide certification that every piece of cast iron frame, grate, cover and curb box supplied was manufactured in accordance with these specifications and the approved Material Details.

**B. Material Details.** One copy of the approved Material Details, as referenced on the Approved List.

## 715-08 (VACANT)

## 715-09 MALLEABLE IRON CASTINGS

**SCOPE.** Malleable Iron Castings shall conform to the requirements of ASTM A47. The Grade shall be Grade 32510.

**MATERIAL REQUIREMENTS.** Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended.

The casting shall be boldly filleted at angles and the arrises shall be sharp and perfect. The surface shall have a standard quality finish.

When galvanizing is required, it shall be in accordance with 719-01 *Galvanized Coatings and Repair Methods*, Type II. Particular care shall be exercised so as not to embrittle malleable castings when galvanizing. All galvanized castings shall meet specification requirements after galvanizing.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be in accordance with procedural directives of the Department. *Buy America Requirements Apply.*

## 715-10 (VACANT)

## 715-11 METAL BIN TYPE RETAINING WALL

**SCOPE.** This specification covers the material and quality requirements for metal bin-type retaining walls.

**MATERIAL REQUIREMENTS**

**Base Metal.** The base metal for all components except fasteners shall be manufactured by the open hearth, basic oxygen process or electric furnace process and shall conform to the requirements of AASHTO M218. Base metal for the fasteners shall conform to the requirements of ASTM A307.

**FABRICATION**

**Details.** All members shall be so fabricated that members of the same nominal size shall be freely interchangeable. No drilling, punching or drifting to correct defects in manufacture will be permitted. Any units having holes improperly punched shall be replaced by the Contractor at no expense to the State.

The members in the wall shall conform to the gages, surface treatments and descriptions in Table 715-11, as well as the gages and dimensions shown in the plans. All materials receiving the Type IV surface treatment shall have a nominal zinc coating weight of 2.0 oz/sf such that the minimum check limits for the triple-spot and single-spot tests shall be 2.0 oz/sf and 1.8 oz/sf respectively.

**Configuration.** Walls shall consist of a series of pairs of columns, one column in each pair being in the plane of the wall face and the other column being in the plane of the rear of the wall, with the pair of columns spaced longitudinally with overlapping S-shaped facing and rear members (stringers) and transversely with overlapping U-shaped tie-members (spacers). All necessary bolts and appurtenances shall be furnished to form a continuous closed-face wall of connected bins.

**BASIS OF ACCEPTANCE.** The metal bin-type retaining wall members will be accepted on the basis of the Material Certification and the Engineer's inspection. *Buy America Requirements Apply.*

<b>TABLE 715-11 METAL BIN TYPE RETAINING WALL DETAILS</b>			
<b>Name</b>	<b>Gage</b>	<b>Surface Treatment</b>	<b>Description</b>
Column	8	719-01 Type IV	Vertical Member, Front & Back
Column Cap	12	719-01 Type IV	Cover for front Column
Stringer Stiffener	8	719-01 Type IV	Top flange return
Stringer	16,14,12,10	719-01 Type IV	Horizontal Longitudinal members, front & rear
Connecting Channel	8	719-01 Type I	Connector, Stringer to Column
Spacer	16,14,12	719-01 Type IV	Horizontal Transverse member
Bottom Spacer	16,14,12	719-01 Type IV	Special bottom transverse member
Base Plate	1	719-01 Type I	
5/8 in dia. nuts	¼ in	719-01 Type II	All connections
5/8 in dia. nuts		719-01 Type II	All connections
5/8 in dia. Spring nuts		None	All connections

**715-12 (VACANT)**

**715-13 PREFABRICATED ADJUSTMENT RINGS, FRAMES AND UTILITY VALVE RISERS FOR DRAINAGE UNITS, MANHOLES AND UTILITIES**

**SCOPE.** This specification covers the material requirements and fabrication of adjustment rings, frames and utility valve risers for drainage structures, manholes and utilities.

The adjustment rings, frames and utility valve risers shall consist of one of the following types unless otherwise approved by the Director, Materials Bureau:

### **RINGS**

Type AR1 - Single Height Segmented Unit

Type AR2 - Single Height - One Cut Unit

Type AR3 - Single Height - Solid Unit

### **FRAMES**

Type AF1 - Single Height Segmented Unit

Type AF2 - Single Height Solid Unit

### **UTILITY VALVE RISERS**

Type UVR1 - Single Height - Solid Ring Unit

Type UVF1 - Single Height - Solid Frame Unit

**MATERIAL REQUIREMENTS** All adjustment rings, frames and utility valve risers shall be fabricated from steel, iron castings, a combination of these two materials, or an alternative material or materials as approved by the Director of the Materials Bureau.

The steel used for fabrication of rings, frames and utility valve risers shall meet the requirements of ASTM A709-36, A108, A242 or equivalent. If cast iron is used, the cast iron units shall be iron castings meeting the requirements of 715-05, *Iron Castings*. All welding shall meet the requirements of the New York State Steel Construction Manual. All bolts, nuts, washers and threaded studs shall be stainless steel meeting the requirements of ASTM A240 or equivalent.

**FABRICATION.** All adjustment rings, frames and utility valve risers shall be designed to allow full bearing of the unit on the existing frame seat. Designs shall include a clamping device capable of securing the adjustment ring, frame or utility valve riser to the existing frame. Alternate methods of securing the rings, frames and utility valve risers to the existing frame shall be approved by the Director, Materials Bureau. All adjustment rings, frames and utility valve risers shall be reinforced to prevent bending during construction and routine service.

Steel rings, frames and utility valve risers shall be galvanized in accordance with 719-01 *Galvanized Coatings and Repair Methods*. When steel rings, frames and utility valve risers contain no component parts which are less than 1/4 inch in thickness, they may be coated with a bituminous base or coal tar product and will not require galvanizing. Any alternate coating system shall be approved by the Director, Materials Bureau. Cast iron rings, frames and utility valve risers do not require any galvanizing, but may instead be coated with a bituminous based or coal tar product approved by the Director, Materials Bureau.

### **Rings**

**Type AR1 - Single Height Segmented Unit.** This ring shall consist of two or more radial segments which may be adjusted to open and close the diameter of the ring. When fully expanded the ring shall bear firmly against the sidewalls and seat of the existing manhole frame.

**Type AR2 - Single Height - One Cut Unit.** This ring shall consist of a single circular unit which is cut through its circumference at one point. The ring shall include an adjusting device that shall enable the ring to be expanded to bear firmly against the sidewalls and seat of the existing manhole frame.

**Type AR3 - Single Height - Solid Unit.** This ring shall consist of a solid unit with no cuts or openings in its circumference. The diameter of this ring is not field adjustable, unless approved by the Materials Bureau..

**Frames**

**Type AF1 - Single Height Segmented Unit.** This frame shall consist of a rectangular, segmented unit which is adjustable for length and width. When expanded the frame shall bear firmly against the sidewalls and seat of the existing frame.

**Type AF2 - Single Height Solid Unit.** This frame shall consist of a solid rectangular unit with fixed lengths and widths.

**Utility Valve Risers**

**Type UVRI - Single Height Solid Ring Unit.** This unit shall consist of a solid ring with no cuts or openings along its length.

**Type UVF1 - Single Height Solid Frame Unit.** This unit shall consist of a solid rectangular with fixed lengths and widths.

**BASIS OF APPROVAL.** The manufacturer or supplier shall prepare and submit Materials Details and the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the manufacturer or supplier along with the drawing number and date assigned to the approved Material Details will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** The Contractor shall provide two copies of the approved Material Details to the Engineer as evidence of acceptability for the product at least 10 days prior to its use. *Buy America Requirements Apply.*

**715-14 HIGH STRENGTH BOLTS, NUTS AND WASHERS**

**SCOPE.** This specification covers the requirements for high-strength steel bolts, nuts and washers used for structural steel connections.

**MATERIAL REQUIREMENTS.** The bolts, nuts and washers shall conform to the provisions of ASTM F3125 GRADE A325, A563, & F436, respectively; and 715-01 except as modified herein.

**Bolt and Nut Dimensions.** Bolt and nut dimensions shall conform to the current requirements of ASME B18.2.6. Alternate fasteners which differ in dimensions from those specified by the ASME may be used provided that the body diameter and bearing areas under the head and nut, or their equivalent areas, are not less than those of the same nominal dimensions specified by the ASME, and that approval for the use is given by the DCES.

**Washer Dimensions.** Circular washers shall be flat and smooth and their nominal dimensions shall conform to the dimensions given in Table 715-14. Beveled washers for American Standard beams and channels shall be square or rectangular, shall have an average thickness of 5/16 inch, and shall conform to the dimensions and taper in thickness given in Table 715-14.

**TESTS AND ACCEPTANCE.** Tests and acceptance of high strength bolts, nuts and washers will be as described in section 10 of the SCM. *Buy America Requirements Apply.*

TABLE 715-14 WASHER DIMENSIONS <sup>1</sup>		
	Circular Washers	Beveled Washer for American Standard Beams and Channels

Bolt Size	Nominal Outside Diam. <sup>2</sup>	Nominal Diam. of hole	Thickness		Min. Side Dimensions	Slope, or Taper in Thickness
			Min.	Max.		
1/2	1 1/16	17/32	0.097	0.177	1 3/4	1:6
5/8	1 5/16	21/32	0.122	0.177	1 3/4	1:6
3/4	1 1/32	13/16	0.122	0.177	1 3/4	1:6
7/8	1 3/4	15/16	0.136	0.177	1 3/4	1:6
1	2	1 1/16	0.136	0.177	1 3/4	1:6
1 1/8	2 1/4	1 1/4	0.136	0.177	2 1/4	1:6
1 1/4	2 1/2	1 3/8	0.136	0.177	2 1/4	1:6
1 3/8	2 3/4	1 1/2	0.136	0.177	2 1/4	1:6
1 1/2	3	1 5/8	0.136	0.177	2 1/4	1:6
1 3/4	3 3/8	1 7/8	0.178 <sup>3</sup>	0.28 <sup>3</sup>	-	-
2	3 3/4	2 1/8	0.178	0.28	-	-
Over 2 to 4 incl.	2D-1/2	D+1/8	0.24 <sup>4</sup>	0.34 <sup>4</sup>	-	-

- NOTES:** 1. Dimensions in inches.  
2. May be exceeded by 1/4 inch  
3. 3/16 inch nominal.  
4. 1/4 inch nominal.

### 715-15 PINS AND ROLLERS

**SCOPE.** This specification covers steel pins and rollers used in bridge construction.

**GENERAL.** The material furnished for pins and rollers shall conform to the following requirements:

- Pins and rollers designed for a minimum yield stress of 36 ksi shall conform to ASTM A668, Class D
- Pins and rollers designed for a minimum yield stress of 50 ksi shall conform to the requirements of ASTM A668, Class F
- Any pin or roller greater than 12 inches in diameter shall be furnished in conformance with the requirements of ASTM A668, Class G.

**BASIS OF ACCEPTANCE.** Tests are to be performed as required in the applicable ASTM Designation. Certified copies of the results of the specified tests are to be furnished as described in “Basis of Acceptance,” of 715-01 *Structural Steel*. Acceptance of material will be based on satisfactory test results and dimensional compliance with the contract documents. *Buy America Requirements Apply*.

### 715-16 STAINLESS STEEL CONNECTING PRODUCTS

**SCOPE.** This specification covers stainless steel bolts, nuts, washers, and set screws used in the construction of sign structures.

**MATERIAL REQUIREMENTS.** Stainless steel connecting products shall conform to the following:

- Hex bolts designed for 85 ksi minimum yield strength shall conform to the requirements of ASTM A193, Grade B6 (AISI 410).
- Nuts for Grade B6 bolts shall conform to the requirements of ASTM A194, Grade B6 (AISI 416).
- Hex bolts and U-bolts designed for 30 ksi minimum yield strength shall be either AISI 304 or 305 stainless steel conforming to the requirements of ASTM A193, Grade B8 or Grade B8P, Class 1.



- Hex bolts and U-bolts designed for 100 ksi minimum yield strength shall be either AISI 304 or 305 stainless steel conforming to the requirements of ASTM A193, Grade B8 or Grade B8P, Class 2.
- Nuts for Grade B8 or Grade B8P bolts shall conform to the requirements of ASTM A194, Grade B8 (AISI 304).
- Flat washers shall be circular, flat, smooth, and fabricated from material conforming to the requirements of ASTM A167 (AISI 302B (UNS S30215) or ASTM A240 (AISI 302 or 304 (UNS S30200 or S30400))).
- Lock washers shall be fabricated in accordance with ANSI B18.21.1 from material conforming to the requirements of ASTM A313 (AISI 302, 304, or 305 (UNS S30200, S30400, or S30500)) with a hardness Rc 35-43.
- Set screws shall conform to the requirements of ASTM A320, Grade B8F (AISI 303).

**Cleaning.** Following heat treatment, all stainless steel connecting products shall be descaled and cleaned in accordance with the requirements of ASTM A380. After cleaning and descaling the stainless steel hardware shall be passivated. Stainless steel hardware with a black or speckled rusty appearance is acceptable provided the discoloration does not run when installed.

**Delivery.** All stainless steel connecting products shall be delivered to the project site no less than 30 days prior to utilization of the hardware to allow ample time for sampling and testing.

**SAMPLING AND TESTING.** Stainless steel connecting products will be sampled at the project site or supply location. Sampling and testing will be in accordance with procedural directives of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Stainless steel connecting products will be accepted in stock-lot quantities at the project site or supplier's location in accordance with procedural directives of the Materials Bureau. Grade B8 bolts less than 3/8 inch in diameter will be accepted based on chemical properties only. *Buy America Requirements Apply.*

## 715-17 STEEL SHEETING

**SCOPE.** This section provides the material and quality requirements for steel sheeting.

**MATERIAL REQUIREMENTS.** Steel sheeting shall meet the requirements of §715-01 *Structural Steel* and the requirements of ASTM A328M.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of a material certification as described in Basis of Acceptance §715-01 *Structural Steel*. *Buy America Requirements Apply to all permanent and interim applications.* Temporary steel which is not removed after completion of the work is considered a permanent application.

## 715-18 SOLDIER PILES

**SCOPE.** This section provides the material and quality requirements for soldier piles.

**MATERIAL REQUIREMENTS.** Soldier piles shall meet the requirements of §715-01 *Structural Steel* except that the use of ASTM A588M is prohibited.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of a material certification as described in Basis of Acceptance 715-01 *Structural Steel*. *Buy America Requirements Apply to all*

*permanent and interim applications.* Temporary steel which is not removed after completion of the work is considered a permanent application.

**715-99 FOR SITE MANAGER USE**

**SECTION 716 - BEARINGS AND EXPANSION PLATES**

(Last Revised May, 2016)

**716-01 THRU 716-02 (VACANT)**

**716-03 POLYETHER URETHANE STRUCTURAL ELEMENT**

**SCOPE.** This specification covers the material requirements for Polyether Urethane Structural Element.

**GENERAL.** The polyether urethane structural element used in the construction of disc-design bearings shall be molded from a polyether urethane compound.

**MATERIAL REQUIREMENTS.** The physical properties of the polyether urethane shall conform to the requirements of Table 716-03-1.

<b>TABLE 716-03-1 PHYSICAL REQUIREMENTS OF POLYETHER URETHANE STRUCTURAL ELEMENT</b>			
<b>Physical Property</b>	<b>ASTM Test Method</b>	<b>Requirements</b>	
		<b>Min.</b>	<b>Max.</b>
Hardness, Type D Durometer	D2240	57	67
Tensile Stress, psi <sup>1</sup> At 100% elongation At 300% elongation <sup>3</sup>	D412	2000 3750	-----
Tensile Strength, psi <sup>1</sup>	D412	5000	---
Ultimate Elongation, % <sup>1</sup>	D412	220	---
Compression Set <sup>1,2</sup> , %	D395	---	40

- NOTES:**
1. 10% deviation from specified values is permissible.
  2. 22 hours at 158°F
  3. Only required if 300% is attained

**SAMPLING AND TESTING.**

<b>TABLE 716-03-2 POLYETHER URETHANE SAMPLING AND TESTING REQUIREMENTS</b>		
<b>Test</b>	<b>Performed By</b>	<b>Samples Required</b>
Physical Properties Polyether Urethane Rotational Element (except compression set)	Materials Bureau	One 10 x 15 inch sheet of polyether urethane material (thickness of 1/16 - 1/8 inch) per lot. <sup>1</sup>
Compression Set of Polyether Urethane Rotation Element	Materials Bureau	One 4 x 4 inch sheet of polyether urethane material, molded or cut to the thickness requirements of ASTM D395, Method B. <sup>2</sup>

**NOTES:**

1. All submitted sample sheets of polyether urethane material shall be certified by the bearing manufacturer as having been taken from the same batch of polyether urethane material as was used in the actual production bearings.
2. The manufacturer shall have the option of supplying four (4) die cut specimens in accordance with ASTM D395, Method B. All submitted specimens of polyether urethane material shall be certified by the bearing manufacturer as having been taken from

the same batch of polyether urethane material as was used in the actual production bearings.

**BASIS OF ACCEPTANCE.** Polyether Urethane Structural Element will be considered for acceptance in lot quantities in accordance with the procedural directives of the Materials Bureau.

**716-04 POLYTETRAFLUOROETHYLENE SHEET AND STRIP**

**SCOPE.** This specification covers the material requirements for Polytetrafluoroethylene (PTFE) sheet and strip.

**GENERAL.** Polytetrafluoroethylene (PTFE) sheet and strip shall be manufactured from pure virgin (not processed) unfilled TFE resin; or from TFE resin uniformly blended with either 15% glass fiber or 25% carbon (maximum filler, percent by weight).

**MATERIAL REQUIREMENTS.** Finished PTFE sheet and strip shall be resistant to all acids, alkalis and petroleum products, stable at temperatures from -360°F to +500°F, non-flammable, non-absorbing of water, and shall conform to the physical requirements of Table 716-04-1.

<b>TABLE 716-04-1 PHYSICAL REQUIREMENTS OF PTFE SHEET AND STRIP</b>				
<b>Physical Property</b>	<b>ASTM Test Method</b>	<b>MINIMUM REQUIREMENTS</b>		
		<b>Unfilled</b>	<b>Filled 15% Glass</b>	<b>Filled 25% Carbon</b>
Ultimate Tensile Strength, psi	D638M	2800	2000	1300
Ultimate Elongation, %	D638M	200	150	75
Specific Gravity	D792	2.13	2.18	2.05

**SAMPLING AND TESTING.** One 10 x 15 inch sheet of PTFE material per lot as per 716-07. Single sheets of PTFE Material from which the bearing has been fabricated may be submitted to the Materials Bureau for consideration of multiple lot acceptance, provided that the thickness of the material does not vary from lot to lot. All submitted sample sheets shall be certified by the bearing manufacturer as having been taken from the same batch of PTFE material as was used in the actual production of bearings.

**BASIS OF ACCEPTANCE.** Polytetrafluoroethylene (PTFE) sheet and strip will be considered for acceptance in lot quantities in accordance with the procedural directives of the Materials Bureau.

**716-05 SELF-LUBRICATING BRONZE PLATES**

**SCOPE.** This specification covers requirements for self-lubricating bronze plates used as bearing plates in expansion bearings.

**MATERIAL REQUIREMENTS.** Self-lubricating bronze shall conform to the requirements of ASTM B22, Alloy 911.

The lubricant shall be of the solid type and shall consist of graphite, metallic substances having lubricating properties and a lubricating binder. Materials which do not have lubricating qualities or promote chemical or electrolytic reactions, shall not be acceptable. The lubricant shall be integrally molded and compressed into the lubrication recesses with hydraulic pressure of at least five times the maximum design unit loading to form a dense, non-plastic lubricant which shall project above the surface of the bronze a minimum of 0.005 inch.

The recesses for the lubricant shall consist of annular rings with or without central circular recess with a depth at least equal to the width of the ring or diameter of hole for proper containment of lubricant.

The recesses shall be arranged in a geometrical pattern such that successive rows shall overlap in the direction of motion and the distance between extremities of recesses shall be closer in the direction of motion than that perpendicular to motion. The entire bearing area of all surfaces which have provision for motion shall be lubricated by means of these lubricant filled recesses. The total area of these recesses shall comprise not less than 25 percent nor more than 35 percent of the total bearing area of the plate.

The bearing plates shall be furnished to the sizes and shapes specified on the plans. The maximum permissible variation in the specified thickness of bronze plates shall be  $\pm 0.01$  inch. The lay of the tool marks shall be in the direction of motion or shall be omnidirectional.

On flat faces the machined surface shall be flat to a tolerance of 0.0005 inches in each inch of length and width.

On curved faces the radius of the machined surface shall have the following tolerances:

	<b>Positive tolerance</b>	<b>Negative tolerance</b>
Concave Surface	0.010 inch	Zero
Convex Surface	Zero	0.010 inch

The curved surface shall be machined to a tolerance of 0.0005 inches in each inch of length perpendicular to the circular section.

Surfaces of bronze plates in contact with machined surfaces of steel plates shall be machine finished in accordance with the requirements of the SCM, Section 6, Part 612 (When the SCM requires DCES approval, delete the term "DCES" and replace it with "the Regional Director.>"). Machining shall be of the same surface roughness as that required for sliding bearings.

The coefficient of friction between the self-lubricating bronze plates and the steel plates in contact with them shall not exceed 0.10 when subjected to the maximum designed unit loading and also at twice the maximum design unit loading.

**BASIS OF ACCEPTANCE.** The manufacturer shall supply the Engineer with certification that the bronze plate was manufactured in accordance with this specification. This certification must be received by the Engineer prior to the placement of the bronze plate or any fabricated piece containing the bronze plate into any construction work.

## **716-06 DISC-DESIGN STRUCTURAL BRIDGE BEARINGS**

**SCOPE.** This specification covers the material requirements for disc-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.

**GENERAL.** Disc-design structural bridge bearings shall consist of a polyether urethane structural element (disc) confined by upper and lower steel bearing plates. The bearings shall be equipped with a shear restriction mechanism to prevent movement of the disc.

Disc-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

**Fixed Bearings.** Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane.

**Guided Expansion Bearings.** Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. To allow longitudinal movement, the upper steel bearing plate shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be

faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

**Non-Guided Expansion Bearings.** Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. To allow longitudinal and transverse movement, the upper steel bearing plate shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel top bearing plate shall be faced with polished stainless steel.

**MATERIAL REQUIREMENTS.** All material shall be new and unused, with no reclaimed material incorporated in the finished bearing.

**Polyether Urethane Structural Element.** The polyether urethane structural element shall meet the requirements of 716-03.

**Steel.** All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual.

**Stainless Steel.** Stainless steel shall conform to the requirements of ASTM A167, or ASTM A240, Type 304. Stainless steel in contact with PTFE shall be polished to a No. 8, bright mirror finish. The minimum thickness of the stainless steel shall be 0.05 inches.

**Polytetrafluoroethylene Sheet and Strip.** Polytetrafluoroethylene (PTFE) sheet and strip shall meet the requirements of 716-04.

**FABRICATION.** The finish of the mold used to produce the bearing elements shall conform to good machine shop practice. Every bearing shall have the Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE sheet shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded, shall be shop painted with one coat of an approved list product meeting 708-01 Structural Steel Paints Class 1. Prior to painting, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. No painting will be done to these surfaces prior to the completion of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010 inch. Out-of-flatness greater than 0.010 inch on any plate shall be cause for rejection. The bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 1/16 inch. Oxygen cut surfaces shall not exceed a surface roughness value of 1 mil, as defined by ANSI B46.1. Repair, when necessary, shall conform to the requirements of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term DCES" and replace it with "the Regional Director).

The steel base pot of all bearings shall be either integrally machined or continuously welded to its bottom steel masonry plate. Unless otherwise approved by the Regional Director, all welding shall

conform to, and all welders shall be qualified in accordance with the requirements of the New York State Construction Manual (When the SCM requires DCES approval, delete the term DCES and replace it with A the Regional Director).

Gross bearing dimensions shall have a tolerance of -0, +1/8 inch.

## PERFORMANCE CHARACTERISTICS

**Compression Strain.** The compression stress is based on the net area of the rotational element using the total overall diameter. The compression strain is measured as a percentage of the original thickness of the rotational element. A load equal to 150% of the bearing's design capacity shall first be applied to seat the bearing components. The 150% load shall then be gradually reduced, over a time period of 30 to 90 seconds, to a pre-load equal to 3% of the bearing's design capacity. Each compression strain shall be recorded relative to the initial 3% pre-load deflection, one minute after the desired stress level has been reached, on deflectometers, at four locations 90° apart on the perimeter of the bearing.

The test results will be evaluated as follows:

- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as extruded elastomer, damaged seals, or cracked steel) shall be cause for rejection
- Non-uniform compression deflections at a desired stress level shall be cause for rejection
- The compression strain of each bearing shall conform to the following requirements:

Compression Stress (psi)	Compression Strain, Max. %
1000	5.0
2000	8.5
3000	11.0
4000	13.2
5000	16.0

**Sliding Coefficient of Friction.** For all guided and non-guided expansion disc-design bearings, the coefficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 1 inch per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:

- The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction
- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged components) shall be cause for rejection.

**Rotation.** For all disc-design bearings, the polyether urethane element shall be capable of maintaining its initial uniform contact with the steel bearing plates throughout a rotation range of 0.02 radians under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:

- The bearing will be visually examined both during and after the test. Any resultant visual defects shall be cause for rejection
- Continuous and uniform contact between the polyether urethane element and bearing plates, and

between the sliding steel top and upper bearing plates shall be maintained for the duration of the test. Any observed lift-off shall be cause for rejection.

**DRAWINGS.** The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Regional Director prior to the start of fabrication.

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings.

- The total quantity of each kind of disc-design bearing required, i.e., fixed, guided expansion, or non-guided expansion, grouped first according to type (load range) and then by actual design capacity
  - The thickness and plan area of the polyether urethane structural elements required
  - The maximum design coefficient of friction as noted on the Contract Plans
  - The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of filler
  - The type(s) of steel(s) to be used
  - If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of New York State Steel Construction Manual shall be clearly described and detailed.
- 
- The location of the fabrication plant
  - The Manufacturer's name and the name of the manufacturer's representative who will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of bearing fabrication. This notification shall include all of the information required as identified above. A copy of this notification shall be sent to the Regional Director.

**SAMPLING AND TESTING.** The manufacturer shall furnish the required number of samples to perform testing in accordance with Table 716-06-3.

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:

- A lot shall not exceed a single contract or project quantity
- A lot shall not exceed 25 bearings
- A lot shall consist of those bearings that can be manufactured with polyether urethane rotation elements from one batch of polyether urethane material. The mass of one batch shall not exceed 450 lbs.
- A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will be considered as a single type.

**Schedule.** The manufacturer shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration. A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

**Sampling Method.** The manufacturer shall select, at random, the required sample bearing(s) from the completed lots of bearings for testing by the manufacturer.

The Department's representative shall select, at random, the required sample bearing(s) from completed lots of bearings, and samples of the polyether urethane and the PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

<b>TABLE 716-06-3 DISC BEARING SAMPLING AND TESTING REQUIREMENTS</b>		
<b>Test</b>	<b>Performed By</b>	<b>Samples Required</b>
Rotation	Manufacturer	One production bearing per lot <sub>1</sub>
Coefficient of Friction	Manufacturer	One production bearing per lot <sub>1</sub>
Compression Strain	Materials Bureau	Three production bearings per lot 2
Physical Properties Polyether Urethane Rotational Element	Materials Bureau	See requirements of 716-03
Physical Properties of PTFE Sheet	Materials Bureau	See requirements of 716-04

**NOTES:**

1. Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150% design capacity which are rejected, will not be retested below 150% design capacity for the purpose of rendering such bearings acceptable. Sample production bearings that cannot be tested by the manufacturer at their actual design capacity for rotation and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost of this testing and submit the certified test results to the Materials Bureau.

2. Bearings with load capacities greater than 600 kip will be tested by an outside laboratory approved by the Materials Bureau. The Department will assume the cost of this testing. The Contractor shall be responsible for transportation, scheduling and related costs. All bearings will be made available for return to the Contractor.

**Finish and Accessories.** All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

Bearings with tapered sole plates which are selected for testing by the Materials Bureau, shall be delivered to the test site accompanied by a single unattached matching beveled plate. This plate shall be made of the same material and be the same size and thickness as the tapered plate. Additionally, the single beveled plate shall be so constructed that when placed in contact with the tapered sole plate the two shall form a single body, rectangular in shape and uniform in thickness.

**Shipping Costs.** The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

**BASIS OF ACCEPTANCE.** Acceptance of Disc Bearings will be based on the manufacturer's name appearing on the Department's Approved List for Disc Bearings (716-06). Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

**716-07 POT-DESIGN STRUCTURAL BRIDGE BEARINGS**

**SCOPE.** This specification covers the material requirements for pot-design structural bridge bearings. Bearings furnished under this specification shall adequately provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members, where applicable.



**GENERAL.** Pot-design structural bridge bearings shall be supplied as fixed bearings; guided expansion bearings; and non-guided expansion bearings as designated by the Contract Documents.

**Fixed Bearings.** Fixed bearings shall allow rotation but no longitudinal or transverse movement in the bearing plane. Fixed bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot.

**Guided Expansion Bearings.** Guided expansion bearings shall allow rotation and longitudinal movement in the bearing plane; transverse movement shall be restricted. Guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal movement, the upper surface of the steel piston shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel. To restrict transverse movement, either a guide bar or keyway system shall be used. If required, the guide bar or keyway systems and their mating steel surfaces shall be faced with strips of either PTFE or PTFE-stainless steel.

**Non-Guided Expansion Bearings.** Non-guided expansion bearings shall allow rotation, longitudinal, and transverse movement in the bearing plane. Non-guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot. To allow longitudinal and transverse movement, the upper surface of the steel piston shall be faced with polytetrafluoroethylene (PTFE) sheet and support a sliding steel top bearing plate. The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel.

**MATERIAL REQUIREMENTS.** All material shall be new and unused, with no reclaimed material incorporated in the finished bearing.

**Elastomeric Rotational Element.** The elastomeric rotational element used in the construction of potdesign bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The physical properties of neoprene and natural rubber used in these bearings shall conform to ASTM or AASHTO requirements, with modifications as noted, in Table 716-07-1.

<b>TABLE 716-07-1 PHYSICAL REQUIREMENTS OF ELASTOMERIC BEARING MATERIAL</b>		
<b>Elastomeric Compound</b>	<b>ASTM Requirement</b>	<b>AASHTO Standard Specifications for Bridge</b>
Neoprene	D2000, Line Call Out M2BC517A14B34	Section 2.25.2, Materials, 50 Durometer Hardness
Natural Rubber	D2000, Line Call Out M4AA517A13B33	Section 2.25.2, Materials, 50 Durometer Hardness

**NOTES:**

1. The Shore A Durometer hardness shall be 50±10 points.
2. Samples for compression set tests shall be prepared using a Type 2 die. The compression set of the neoprene specimens shall not exceed 35%. The compression set of the natural rubber specimens shall not exceed 25%.
3. For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded off to the nearest 10 psi for tensile strength, to the nearest 10% for elongation, and to the nearest 1% for the change in aged tensile and aged elongation. Hardness and aged hardness shall be rounded off to the nearest point.

**Sealant.** If used, the type of sealant between the steel base pot and the top steel bearing plate shall be as recommended by the Manufacturer.

**Sealing Rings.** The sealing rings between the steel piston and the elastomeric rotational element shall be brass formed to the size recommended by the Manufacturer.

**Steel.** All steel except stainless steel components of the bearing shall conform to the requirements of the type of steel designated on the Contract Plans and applicable provisions of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term DCES and replace it with the Regional Director).

**Stainless Steel.** Stainless steel shall conform to the requirements of ASTM A167, or ASTM A240, Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8. bright mirror finish. The minimum thickness of the stainless steel shall be 0.050 inch.

**Polytetrafluoroethylene Sheet and Strip.** Polytetrafluoroethylene (PTFE) sheet and strip shall meet the requirements of 716-04.

**FABRICATION.** The finish of the mold used to produce the elastomeric rotational elements shall conform to good machine shop practices. Every bearing shall have the Contract D#, Project Identification Number, NYSDOT Lot Number and individual bearing number indelibly marked with ink on a side that will be visible after erection.

The PTFE shall be bonded to its grit blasted steel substrate using an epoxy resin adhesive under controlled factory conditions in accordance with the instructions of the adhesive manufacturer. Alternately, the PTFE sheet may be recessed into its steel substrate for one-half its thickness. The bearing manufacturer shall have the option of bonding recessed PTFE sheet.

All steel surfaces exposed to the atmosphere, except stainless steel surfaces and metal surfaces to be welded shall be shop painted with one coat of coal-tar epoxy. Coal-tar epoxy paint shall meet the requirements of SSPC Paint Specification No. 16, and be applied at a minimum wet film thickness of 10 mils. Prior to painting, the exposed steel surfaces shall be cleaned with the recommendations of the coating's manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating approved by the Engineer, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010 inch. Out-of-flatness greater than 0.010 inch on any plate shall be cause for rejection. The bottom surface of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 1/16 inch. Oxygen cut surfaces shall not exceed a surface roughness value of 1 mil, as defined by ANSI B46.1. Repair, when necessary shall conform to the requirements of the New York State Steel Construction Manual.

The steel base pot of all bearings shall be either integrally machined or continuously welded to its bottom steel masonry plate. Unless otherwise approved by the Regional Director, all welding shall conform to, and all welders shall be qualified in accordance with, the requirements of the New York State Steel Construction Manual (When the SCM requires DCES approval, delete the term DCES and replace it with the Regional Director).

Gross bearing dimensions shall have a tolerance of -0, +1/8 inch.

## **PERFORMANCE CHARACTERISTICS**

**Sliding Coefficient of Friction.** For all guided and non-guided expansion type pot-design bearings, the sliding coefficients of friction shall be measured at the bearing's design capacity, on the fifth and fiftieth cycles, at a sliding speed of 1 inch per minute.

The sliding coefficient of friction shall be calculated as the horizontal load required to maintain continuous sliding of one bearing, divided by the bearing's design capacity vertical load. The vertical load shall have been applied continuously for a minimum of 12 hours prior to testing.

The test results will be evaluated as follows:

- The measured sliding coefficients of friction shall not exceed 75% of the maximum design coefficient of friction
- The bearing will be visually examined both during and after the test. Any resultant visual defects (such as bond failure, physical destruction, cold flow of PTFE, or damaged bearing components) shall be cause for rejection.

**Rotation.** For all pot-design bearings, the elastomeric rotational element shall be capable of maintaining its initial uniform contact with the steel piston and steel base pot throughout a rotation range of 0.02 radians, under a compressive load equal to 150% of the design capacity of the bearing.

The test results will be evaluated as follows:

- The bearing will be visually examined both during and after the test. Any resultant defects shall be cause for rejection
- The sole plate, top bearing plate, and steel piston shall maintain continuous and uniform contact for the duration of the test. Any observed lift-off will be cause for rejection.

**DRAWINGS.** The Contractor shall submit detailed shop drawings, drawn by the Manufacturer only, in conformance with the applicable requirements of the New York State Steel Construction Manual, for approval by the Regional Director prior to the start of the fabrication. (When the SCM requires DCES approval, delete the term DCES and replace it with the Regional Director).

In addition to the above requirements, the Manufacturer shall note the following on the shop drawings.

- The total quantity of each kind of pot-design bearing required, (i.e. fixed, guided expansion, or nonguided expansion), grouped first according to type (load range) and then by actual design capacity
- The thickness and plan area of the elastomeric rotational elements and the internal diameters of the steel base pots required
- The maximum design coefficient of friction as noted on the Contract Plans
- The type of PTFE sheet (filled or unfilled) and, if applicable, the type and amount (by weight) of Filler.
- The type(s) of steel(s) to be used
- If applicable, any welding process used in the bearing manufacture that does not conform to the approved processes of the New York State Steel Construction Manual shall be clearly described and detailed. (When the SCM requires DCES approval, delete the term DCES and replace it with the Regional Director).
- The location of the fabrication plant
- The Manufacturer's name and the name of the manufacturer's representative will be responsible for coordinating production, inspection, sampling and testing with the Materials Bureau.

The Contractor shall also provide the Materials Bureau with written notification thirty (30) days prior to the start of the bearing fabrication. This notification shall include all of the information required as identified above. A copy of this notification shall be sent to the Regional Director.

## **SAMPLING AND TESTING**

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as the smallest number of bearings as determined by the following criteria:

- A lot shall not exceed a single contract or project quantity
- A lot shall not exceed 25 bearings

- A lot shall consist of those bearings of the same type, regardless of load capacity. Bearing types shall be fixed type bearings or expansion type bearings. Guided and non-guided expansion bearings will be considered a single type.

**Sampling and Testing Requirements.** The manufacturer shall furnish the required number and size of samples to perform testing in accordance with Table 716-07-3.

A minimum of thirty (30) days shall be allowed for the Department's inspection, sampling and testing of production bearings and component materials.

All exterior surfaces of sampled production bearings shall be smooth and free from irregularities or protrusions that might interfere with testing procedures.

The manufacturer shall select, at random, the required sample bearing(s) from completed lots of bearings for testing by the manufacturer. The manufacturer shall complete the required testing and determine compliance with this specification before submitting the lot(s) for inspection, sampling and acceptance consideration.

The Department's representative shall select, at random, samples of elastomeric and PTFE materials for testing by the Materials Bureau. All samples shall be taken in accordance with the Department's written instructions.

The Contractor shall assume the cost of transporting all samples from the place of manufacture to the Materials Bureau and return, or, if applicable, to the project site.

<b>TABLE 716-07-3 POT BEARING SAMPLING AND TESTING REQUIREMENTS</b>		
<b>Test</b>	<b>Performed By</b>	<b>Samples Required</b>
Rotation	Manufacturer	One production bearing per lot <sup>1</sup>
Coefficient of Friction	Manufacturer	One production bearing per lot <sup>1</sup>
Physical Properties of Elastomeric Rotational Element Materials Bureau	Materials Bureau	One Elastomeric element per lot. <sup>2</sup>
Physical Properties of PTFE Sheet	Materials Bureau	See 716-04

**NOTES:**

1. Sample production bearings of such size that cannot be tested by the manufacturer at 150% design capacity for rotation shall be tested at actual design capacity. Bearings which are tested at actual design capacity will be tested at that capacity because it is not possible, or not practical in the Department's opinion to test them at a higher capacity. Therefore, bearings tested at 150% design capacity which are rejected, will not be retested below 150% design capacity for the purpose of rendering such bearings acceptable. Sample production bearings that cannot be tested by the manufacturer at their actual design capacity for rotation and/or friction shall be tested by an outside laboratory selected by the Materials Bureau. The Manufacturer shall assume the cost of this testing and submit the certified test results to the Materials Bureau.

2. At the time of sampling the Department representative shall remove an elastomeric rotational element from a production bearing (not from a bearing that requires compressive strain testing) and forward it to the Materials Bureau for test. This testing will be destructive and the manufacturer shall, at the cost of the manufacturer, replace the sample elastomeric element.

**BASIS OF ACCEPTANCE.** Acceptance of Pot Bearings will be based on the manufacturer's name appearing on the Department's Approved List for Pot Bearings (716-07). Bearings will be considered for acceptance in project lot quantities, or portions thereof, at the manufacturing site in accordance with the procedural directives of the Materials Bureau.

**716-08 (VACANT)**

**716-09 FOR SITE MANAGER USE**

## 716-10 PLAIN ELASTOMERIC BRIDGE BEARINGS

**SCOPE.** This specification covers the material requirements for plain elastomeric bridge bearings. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, creep, and shrinkage of structural members.

**GENERAL.** Plain elastomeric bridge bearings (Type EP bearings) are composed entirely of elastomeric material. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

**MATERIAL REQUIREMENTS.** All materials shall be new with no reclaimed material incorporated in the finished bearing. The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall meet the requirements of Table 716-10-1.

The manufacturer shall certify that the elastomeric compound passes Grade 3 Low - Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

**DRAWINGS.** Shop drawings are not required for Type EP bearings.

**FABRICATION.** The finish of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the manufacturer's name and location. The marking shall be placed on at least one side or face that will be visible after erection and, if possible, on two sides or faces.

**TABLE 716-10-1 PROPERTIES OF ELASTOMERIC MATERIAL**

PHYSICAL PROPERTIES:	ASTM TEST METHOD	REQUIREMENTS	
		NEOPRENE	NATURAL RUBBER
Tensile Strength, Min., (psi)	D412	2000	2000
Ultimate Elongation, Min., (%)	D412	400	400

**NOTES:**

1. Tolerances for samples cut from finished parts have already been applied to each of these requirements. No greater tolerances will be allowed.
2. For the purpose of determining conformance with these specifications, an observed or calculated value shall be rounded off to the nearest 10 psi for tensile strength and to the nearest 10% for elongation.

The bearings shall be cast in a mold under pressure and heat to the specified thickness.

They may be molded and vulcanized in large sheets and cut to size. Cutting shall not heat the material, and the finish produced shall be equal to a surface roughness average of 2 mils as defined by ANSI B46.1. A type EP bearing that has been cut from a larger piece of material and fabricated to the finished size by bonding or plying smaller pieces together will not be acceptable.

**Bearing Tolerances.** Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-10-2.

**TABLE 716-10-2 BEARING TOLERANCES**

<b>Dimension</b>	<b>Tolerance</b>
Overall Vertical	-0, +1/8 inch
Overall Horizontal	-0, +1/4 inch
Position of Holes and Slots centerline	±1/16 inch from centerline
Size of Holes, Slots and Internal Steel Plates	-0, +1/16 inch

## PERFORMANCE CHARACTERISTICS

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 500 psi and 800 psi. At each load a deflection reading will be taken and the readings used to calculate the slope between the two loads. The slope shall then be used to determine the deflection at the bearing's design load.

The bearing and ambient temperature shall be  $75^{\circ}\text{F} \pm 5^{\circ}\text{F}$  at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based upon the manufacturer's name appearing on the Department's Approved List for Elastomeric Bridge Bearings, and a manufacturer's certification stating conformance with these specifications.

## 716-11 STEEL LAMINATED ELASTOMERIC BRIDGE BEARINGS

**SCOPE.** This specification covers the material requirements for steel laminated elastomeric bridge bearings without external load plates. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, creep, and shrinkage of structural members.

**GENERAL.** Steel laminated elastomeric bridge bearings (Type EL bearings) are composed of multiple layers of elastomeric material separated by steel plates. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

**MATERIALS REQUIREMENTS.** All materials shall be new with no reclaimed material incorporated in the finished bearing.

**Elastomeric Material.** The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall be determined by using samples taken from bearings and shall meet the requirements of Table 716-10-1.

The manufacturer shall certify that the elastomeric compound passes Grade 3 Low - Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

**Internal Steel Plates.** Steel plates for internal laminates shall be rolled mild steel conforming to the requirements of ASTM A36M, ASTM 1008/A1008/M or ASTM 1011/A1011/M (Grade 33, 36 and 40).

**DRAWINGS.** Shop drawings are not required for Department approval unless a change in the details shown on the plans is proposed. When Department approved shop drawings are required, they shall be furnished in accordance with the Steel Construction Manual (SCM), Section 2, except that in place of two sets of Department approved drawings submitted to the designated Shop Inspection Agency, five sets of Department approved drawings shall be submitted to the Materials Bureau. The Contractor shall submit one copy of these drawings to the Engineer.

When the bearing details are identical to the plans, the Contractor shall be responsible for supplying shop drawings prepared by the Manufacturer. The Manufacturer shall certify that the bearings depicted on the drawings are in conformance with the contract documents. The Contractor shall submit one copy of the certified drawings to the Engineer and five copies of their certified drawings to the Materials Bureau. The Department's acceptance procedures will commence subsequent to receipt of these drawings. The Manufacturer shall note the following on all shop drawings:

- The Contract number, bridge identification number (BIN), feature carried/feature crossed, specification pay item no. and the type, size and quantity of bearings being produced.
- The design load (dead load plus live load) for each type and size bearing. If bearings of the same type and size are designed for differing load conditions the maximum design load shall be noted.
- The effective rubber thickness, typical laminate thickness, compressive area, shear area and shape factor.
- The Manufacturer's name, the location of the fabrication plant and the name and phone number of the Manufacturer's representative who will coordinate production, inspection, and sampling and testing with the Materials Bureau.
- The specification reference and grade of steel used.

**FABRICATION.** The finish of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the manufacturer's name, contract number, lot number, and individual bearing number. The marking shall be placed on at least one side or face that will be visible after erection and, if possible, on two sides or faces.

Type EL bearings shall be cast as a single unit in a mold and bonded and vulcanized under pressure and heat to the specified size and thickness. The internal steel plate(s) shall be commercially blast cleaned to a condition matching that of SSPC-Vis1, Pictorial Standards A SP6, B SP6 or C SP6, and cleaned of all oil or grease before bonding.

**Bearing Tolerances.** Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-11 and the following details:

<b>TABLE 716-11 BEARING TOLERANCES</b>	
<b>Dimension</b>	<b>Tolerance</b>
Overall Vertical	-0, +1/8 inch
Overall Horizontal	-0, +1/4 inch
Position of Holes and Slots centerline	±1/16 inch from centerline
Size of Holes, Slots and Internal Steel Plates	-0, +1/16 inch
Edge Cover over External Steel Plates <sup>1</sup>	1/8 inch min.
Bedding Surface (Top and Bottom) Over Internal Steel Plates	1/4 inch min.

NOTES:

1. No edge cover will be required over internal details that will not be exposed after erection (i.e.- vertical holes covered by bearing seats or flanges).
2. For 716-12, With external load plate(s) there shall be an effective rubber laminate between the load plate(s) and internal steel plate(s).

**A. Internal Steel Plates.** The internal steel plates shall be checked for parallelism by measuring the distance between each individual steel plate, and between the top or bottom edge of the bearing to the first adjacent steel plate. For rectangular bearings, take measurements for each plate along the vertical surface of the bearing, located 1 inch from the edge of the four alternate corners. For round bearings, measurements will be taken at four points located at 90° intervals around the perimeter. The smallest of the four measurements shall be recorded for each plate. The cumulative total of these measurements shall not be less than 75% of the design effective rubber thickness.

**B. Elastomeric Laminae.** The average thickness of individual layers of elastomer in steel laminated elastomeric bearings shall not vary more than ±20% of the design thickness and in no case exceed the design thickness by 1/8 inch. Average thickness will be calculated from measurements taken at four points, located at 1 inch from the edge of the four alternate corners for rectangular bearings and at 90° intervals around the perimeter for round bearings.

## PERFORMANCE CHARACTERISTICS

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 500 psi and 800 psi. At each load a deflection reading will be taken and the readings used to calculate a slope between the two loads. The slope shall then be used to determine the deflection at the bearing's design load.

The bearing and ambient temperature shall be 75°F ± 5°F at the time of testing.

**Adhesion.** The adhesion of the elastomer to the internal plates shall be demonstrated by subjecting the bearing to a compressive load equal to 150% of the actual design load. Upon visual examination, the bearing shall be free of visual defects.

The bearing and ambient temperature shall be 75°F ± 5°F at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

## SAMPLING AND TESTING

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:

- A lot shall not exceed a single contract quantity.
- A lot shall consist of bearings with the elastomer being of the same dimensions and configuration.
- A lot shall consist of bearings produced in a continuous manner.

**Procedure.** The Department's representative shall select at random the required sample bearings from completed lots of bearings for testing by the Materials Bureau. Bearings with a plan area of less than 4 sf shall be tested for performance characteristics by the Materials Bureau. Bearings with a plan area greater than 4 sf shall be tested by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing the sampled bearings and the Contractor shall assume the responsibility and cost of transporting the sampled bearings from the place of



manufacture to the testing laboratory. After testing, the Contractor has the responsibility for the cost of transporting the sampled bearings back to the bearing manufacturer or, if applicable, to the project site. All samples shall be taken and delivered for tests in accordance with the Department's written instructions. A minimum of thirty (30) days shall be allowed for inspection, sampling and testing by the Materials Bureau. This thirty days is exclusive of shipping time which is the Contractor's responsibility. The sampling procedure and test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Department's Approved List for Elastomeric Bridge Bearings and in accordance with the procedural directives of the Materials Bureau.

## **716-12 ELASTOMERIC BRIDGE BEARINGS WITH EXTERNAL LOAD PLATES**

**SCOPE.** This specification covers the material requirements for elastomeric bridge bearings with external load plates. Bearings furnished under this specification shall be adequate for the specified design load, and provide for the thermal expansion and contraction, rotation, camber changes, and creep and shrinkage of structural members.

**GENERAL.** Elastomeric bridge bearings with external load plates (Type EB bearings) are composed of either plain elastomeric or laminated elastomeric bearings with external steel load bearing plates. The steel load bearing plates are bonded to the elastomer by vulcanization during the primary molding process. These bearings may be used for both fixed and expansion applications with appropriate changes in details, as shown on the contract plans. The bearings will accommodate longitudinal, transverse, and rotational movements.

Elastomeric bridge bearings with external load plates shall be designed in accordance with New York State Standard Specifications for Highway Bridges.

**MATERIALS REQUIREMENTS.** All materials shall be new with no reclaimed material incorporated in the finished bearing.

**Elastomeric Material.** The elastomeric compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. The resulting product shall be free of porous areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability. The physical properties of the cured elastomeric compound shall be determined by using samples taken from bearings and shall meet the requirements of Table 716-10-1.

The manufacturer shall certify that the elastomeric compound passes Grade 3 Low - Temperature Brittleness as determined by ASTM D746 - Brittleness Temperature of Plastics and Elastomers by Impact Procedure B.

**Internal Steel Plates.** Steel plates for internal laminates shall be rolled mild steel conforming to the requirements of ASTM A36, or ASTM 1008/A1008/M ASTM 1011/A1011/M (Grade 33, 36 and 40).

**External Load Bearing Plates and Steel Backing Plates.** External load bearing plates shall conform to the requirements of ASTM A36 and to the requirements of the Steel Construction Manual (SCM), unless otherwise provided for in the contract documents.

Except as noted, all bearing surfaces of external load plates shall be finished or machined flat within 0.010 inch. Out-of-flatness greater than 0.010 inch on any plate, except the bottom surface of the lower external plates (masonry plates), shall be cause for rejection. The bottom surface of lower external load plates (masonry plates) shall not exceed an out-of-flatness value of 1/16 inch.

Oxygen cut surfaces shall not exceed a surface roughness average of 1 mil as defined by ANSI B46.1. Repairs shall conform to the requirements of the SCM.

External load bearing plate surfaces to be welded shall be painted with one coat of lacquer or other protective coatings approved by the Director of the Materials Bureau. This coating shall be removed before welding. All surfaces shall be cleaned and painted in accordance with §572, Structural Steel Paint System, Shop Applied. Color shall match that of the finish coat of other structural steel. For bearing used in conjunction with unpainted steel, the finish coat shall match “Weathered Brown” as defined by 708-05 *Standard Paint Colors*.

**DRAWINGS.** Department approval of shop drawings are not required unless a change in the details shown on the plans is proposed. When Department approved drawings are required, they shall be furnished in accordance with SCM, Section 2, except that in place of two sets of Department approved drawings submitted to the designated Shop Inspection Agency, five sets of Department approved drawings shall be submitted to the Materials Bureau. The Contractor shall submit one copy of these drawings to the Engineer.

When the bearing details are identical to the plans, the Contractor shall be responsible for supplying shop drawings prepared by the manufacturer. The manufacturer shall certify that the bearings depicted on the drawings are in conformance with the contract documents. The Contractor shall submit one copy of the certified drawings to the Engineer and five copies of their certified drawings to the Materials Bureau. The Department's acceptance procedures will commence subsequent to receipt of these drawings. The Manufacturer shall note the following on all shop drawings:

- The Contract number, bridge identification number (BIN), feature carried/feature crossed, specification pay item no. and the type, size and quantity of bearings being produced.
- The design load (dead load plus live load) for each type and size bearing. If bearings of the same type and size are designed for differing load conditions the maximum design load shall be noted.
- The effective rubber thickness, typical laminate thickness, compressive area, shear area and shape factor.
- The Manufacturer's name, the location of the fabrication plant and the name and phone number of the manufacturer's representative who will coordinate production, inspection, and sampling and testing with the Materials Bureau.
- The specification references and grades of steel to be used.
- All welding procedures to be used in the manufacture of the bearings.

**WELDING PROCEDURE.** The bearing manufacturer shall submit a Welding Procedure to the Deputy Chief Engineer Structures (DCES) for each welding process to be used in the manufacture of the bearings. No welding shall be performed until the manufacturer receives an approved Welding Procedure.

**FABRICATION.** The finish of the mold used to produce these bearings shall conform to good machine shop practice. Each bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the manufacturer's name, contract number, lot number, and individual bearing number. The marking shall be placed on at least one side or face that will be visible after erection and, if possible, on two sides or faces.

The bearings shall be cast as a single unit in a mold and bonded and vulcanized under pressure and heat to the specified size and thickness. They shall be cast as a single unit with the external load plate(s) bonded to the elastomer by vulcanization during the primary molding process. If internal steel plate(s) are required, they shall be commercially blast cleaned to a condition matching that of SSPC-Vis1, Pictorial Standards A SP6, B SP6 or C SP6, and cleaned of all oil or grease before bonding.

During any welding, the temperature of the steel adjacent to the elastomer shall not exceed 200°F. Temperature shall be controlled by welding procedures and temperature indicating crayons, or other devices approved by the Engineer. Unless otherwise approved by the DCES, all welding shall conform to, and all welders shall be qualified in accordance with the requirements of the SCM.

**Bearing Tolerances.** Finished elastomeric bearings shall conform to the design dimensions, with the tolerances listed in Table 716-11 and the following details:

**A. Internal Steel Plates.** The internal steel plates shall be checked for parallelism by measuring the distance between each individual steel plate, and between the top or bottom edge of the bearing to the first adjacent steel plate. For rectangular bearings, take measurements for each plate along the vertical surface of the bearing, located 1 inch from the edge of the four alternate corners. For round bearings, measurements will be taken at four points located at 90° intervals around the perimeter. The smallest of the four measurements shall be recorded for each plate. The cumulative total of these measurements shall not be less than 75% of the design effective rubber thickness.

**B. Elastomeric Laminae.** The average thickness of individual layers of elastomer in steel laminated elastomeric bearings shall not vary more than ±20% of the design thickness and in no case exceed the design thickness by 1/8 inch. Average thickness will be calculated from measurements taken at four points, located at 1 inch from the edge of the four alternate corners for rectangular bearings and at 90° intervals around the perimeter for round bearings.

### Performance Characteristics

**Compression Deflection.** The compression deflection of each bearing shall not exceed 10.0% of the design effective rubber thickness at a compressive load equal to the actual design load.

The compression deflection shall be determined by loading the bearings to 500 psi and 800 psi. At each load a deflection reading will be taken and the readings used to calculate a slope between the two loads. The slope shall then be used to determine the deflection at the bearing's design load.

The bearing and ambient temperature shall be 75°F ± 5°F at the time of testing.

**Adhesion.** The adhesion of the elastomer to the internal plates shall be demonstrated by subjecting the bearing to a compressive load equal to 150% of the actual design load. Upon visual examination, the bearing shall be free of visual defects.

The bearing and ambient temperature shall be 75°F ± 5°F at the time of testing.

**NOTE:** For conformance to this specification an observed or calculated value shall be rounded off (ASTM E29) to the nearest 0.1% for compression deflection.

### SAMPLING AND TESTING

**Lot Size.** Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as those bearings presented for inspection at a specific time or date. A lot shall be further defined as the smallest number of bearings as determined by the following criteria:

- A lot shall not exceed a single contract quantity
- A lot shall consist of bearings with the elastomer being of the same dimensions and configuration
- A lot shall consist of bearings produced in a continuous manner.

**Procedure.** The Department's representative shall select at random the required sample bearings from completed lots of bearings for testing by the Materials Bureau. The manufacturer shall supply

the Department's representative with a copy of an approved Welding Procedure for each welding process used in the manufacture of the bearings. Bearings with a plan area greater than 4 sf shall be tested by an outside laboratory approved by the Materials Bureau. The Department shall assume the cost of testing the sampled bearings and the Contractor shall assume the responsibility and cost of transporting the sampled bearings from the place of manufacture to the testing laboratory. After testing the Contractor has the responsibility for the cost of transporting the sampled bearings back to the bearing manufacturer or, if applicable, to the project site. All samples shall be taken and delivered for test in accordance with the Department's written instructions. A minimum of thirty (30) days shall be allowed for inspection, sampling and testing by the Materials Bureau. This thirty days is exclusive of shipping time which is the Contractor's responsibility. The sampling procedure and test methods may be obtained from the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Department's Approved List for Elastomeric Bridge Bearings and in accordance with the procedural directives of the Materials Bureau.

#### **716-99 FOR SITE MANAGER USE**

### **SECTION 717 - CONCRETE PROTECTIVE COATINGS**

(Last Revised January, 2020)

#### **717-01 FOR SITE MANAGER USE**

#### **717-02 WATERPROOFING MEMBRANES**

**SCOPE.** This specification covers the material requirements for waterproofing membranes.

**MATERIAL REQUIREMENTS.** Waterproofing membranes shall be spray applied, hot-applied, or sheet applied. All materials used shall be as per each manufacturer's recommendations. Approved Materials Details will be available on the Department's Approved List.

**BASIS OF APPROVAL.** Manufacturers shall submit their product(s) for evaluation to the Director, Materials Bureau. All components of the membrane system shall be clearly identified in the Materials Details submitted to the Department for approval. The Details shall also contain all the preparation requirements and installation instructions. The membrane system will be approved based on successful field performance evaluations at two (2) approved sites for 2 years.

**BASIS OF ACCEPTANCE.** Waterproofing membranes will be accepted on the basis of the manufacturer and the product appearing on the Approved List and a material certification.

#### **717-03 PENETRATING TYPE PROTECTIVE SEALERS**

**SCOPE.** This specification covers the material requirements of penetrating type protective sealers for use on Portland cement concrete.

**GENERAL.** The material shall be a one component material consisting of a penetrating sealer which does not alter the color or texture of Portland cement concrete.

**MATERIAL REQUIREMENTS.** Penetrating sealers shall be a one-part liquid, composed of a minimum of 40% silane or siloxane material, with no petroleum distillates, and containing a fugitive dye that will fade uniformly. The Department will test the sealers as delivered, in accordance with NY 717-01 E, to

ensure that the following properties are attainable. If the material attains these properties, the Department will place the material on its Approved List. The properties are:

**Water Absorption.** The final average percent water absorbed, for concrete coated with the protective sealer, shall not be greater than 20.0% of the final average percent water absorbed by the uncoated reference concrete.

**Moisture Vapor Transmission.** The final average percent moisture loss, for concrete coated with the protective sealer, shall not be less than 75.0% of its final average percent water absorption.

**Chloride Ion Penetration.** The final average absorbed chloride ion content, for concrete coated with the protective sealer, shall not be greater than 15.0% of the final average absorbed chloride ion content of the uncoated reference concrete.

**Durability.** The protective sealer shall not show any signs of weathering, discoloration, or deterioration after 6 months of exposure to atmospheric conditions.

**Volatile Organic Compounds (VOC).** The protective sealer shall meet the VOC requirements of NYCRR part 205.

**Fugitive Dye.** The protective sealer with fugitive dye shall be readily distinguishable upon the concrete surface for at least 4 hours after application but shall become inconspicuous within 7 days after application.

**PACKAGING.** All materials shall be packaged in strong, substantial containers. Each container shall be plainly marked with the following information: name of the product; name and address of Manufacturer; application instructions; lot/batch number; date of manufacture; quantity of material; and date of expiration or shelf life.

**BASIS OF APPROVAL.** The approval of the penetrating type protective sealer shall be based upon the submitted information by the manufacturer and tests and evaluation performed by the Materials Bureau. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List

**BASIS OF ACCEPTANCE.** Acceptance of penetrating type protective sealer will be based upon the product appearing on the Department's Approved List, and the Manufacturer's certification that the material meets the requirements of this section. The shelf life of this material shall not exceed one year from the date of manufacture printed on the product label. The Department reserves the right to sample and test the material at its discretion.

## **717-04 COATING TYPE PROTECTIVE SEALERS**

**SCOPE.** This specification covers the material requirements of coating type protective sealers for use on portland cement concrete.

**GENERAL.** The coating system shall be either a single coating material or a primer coat followed by a top coat. After application, the sealer shall be opaque and uniform in color.

**MATERIAL REQUIREMENTS.** The Department will test the sealers as delivered, in accordance with Department written instructions, to ensure that the following properties are attainable. If the material attains these properties, the Department will place the material on its Approved List. The properties are:

**Water Absorption.** The final average percent water absorbed, for concrete coated with the protective sealer, shall not be greater than 25.0% of the final average percent water absorbed by the uncoated reference concrete.

**Moisture Vapor Transmission.** The final average percent moisture loss, for concrete coated with the protective sealer, shall not be less than 50.0% of its final average percent water absorption.

**Chloride Ion Penetration.** The final average absorbed chloride ion content, for concrete coated with the protective sealer, shall not be greater than 25.0% of the final average absorbed chloride ion content of the uncoated reference concrete.

**Durability.** The protective sealer shall not show any signs of weathering, discoloration, or deterioration after 6 months of exposure to atmospheric conditions.

**PACKAGING.** All materials shall be packaged in strong, substantial containers. Each container shall be plainly marked with the following information: name of the product; name and address of Manufacturer; mix proportions(if applicable) and application instructions; lot/batch number; date of manufacture; quantity of material; and date of expiration or shelf life. The printed shelf life shall not exceed one year from the date of manufacture.

**BASIS OF ACCEPTANCE.** Acceptance of coating type sealers will be based upon the product appearing on the Department's Approved List, and the Manufacturer's certification that the material meets the requirements of this section. The shelf life of this material shall not exceed one year from the date of manufacture printed on the product label. The Department reserves the right to sample and test the material at its discretion.

## **717-99 FOR SITE MANAGER USE**

### **SECTION 718 - PRESTRESSED CONCRETE UNITS**

#### **718-01 PRESTRESSED CONCRETE UNITS (STRUCTURAL)**

**SCOPE.** This specification covers the material and fabrication requirements for prestressed concrete units.

**GENERAL.** Prestressed concrete units provided under this specification shall meet all design requirements for the structure for which they are being fabricated.

#### **MATERIAL REQUIREMENTS**

**Concrete.** The concrete shall meet the requirements of '501-2, under 501, Portland Cement Concrete, General, with the following modifications:

- Cement shall be either Type 1, Type 2 or Type 3. Only one type of cement shall be used to fabricate units for any one structure
- Coarse aggregate gradation shall be No. 1 Size or ASTM D448, No. 67
- Concrete requirements for Classes A and C concrete shall not apply
- Air content shall be 7 percent + 2 percent
- The use of calcium chloride, or an admixture containing calcium chloride will not be permitted.

## Steel.

Bar Reinforcement	709-01
Wire Fabric	709-02
Chairs or other devices to ensure proper placement of steel items	556-2.02
Prestressing steel	709-06
Bearing plates, if required	715-01

**Epoxy.** Epoxy shall meet the requirements of '721-01, Epoxy Resin System; '721-03, Epoxy Polysulfide Grout, or '721-05, Epoxy Repair Paste.

**Fine Aggregate.** Fine aggregate shall meet the requirements of '703-03, Mortar Sand or '703-04, Grout Sand. Fine aggregate shall be absolutely dry.

## DRAWINGS

**Contract Drawings.** Drawings which accompany the contract proposal are designated as contract drawings. These drawings are not intended to be working drawings.

**Working Drawings.** Complete and accurate drawings shall be made by the Contractor, indicating how each prestressed concrete unit is to be fabricated. The Contractor shall be responsible for modifying the dimensions of units to compensate for elastic shortening, shrinkage, grade correction and other phenomena that make in-process fabricating dimensions different from those shown on the contract drawings. Approval of the working drawings by the DCES shall not relieve the Contractor from the responsibility for the correctness of all dimensions shown on these drawings. These drawings shall be made as soon as possible after the award of contract and they shall be designated as working drawings.

**A. Size and Type.** Working Drawings shall be neatly drawn and clearly legible to produce microfilm negatives. The drawings shall be made in ink, or reproduced from the pencil drawings by a process subject to the approval of the DCES, on tracing cloth or mylar of acceptable quality. Working drawings shall be cut to a standard size of 22 x 34 inches (nominal) and arranged to conform to the contract drawings.

Failure to submit working drawings of the required size will be cause for their return without examination. The margin line shall be drawn 1/2 inch from the top, bottom, and right-hand edges and 2 inches from the left-hand edge to permit binding. A space 3 x 11 inches, and parallel to the length of the sheet shall be reserved in the lower right-hand corner for title and approval signature. Each working drawing shall have an identical (top right) corner box to the one shown on the contract drawings. The sheets shall be arranged so that, as far as possible, the notes will appear above each other near the right edge of the sheet.

**B. Information Required on Working Drawings.** The working drawings shall include the following information:

- Plan layout of superstructure indicating the piece mark assigned to each prestressed unit
- Fabricating plant production schedule
- Description of the fabricating plant, including any backup concrete mixing facilities, original design mix and proposed method of placement. Modifications or deviations from the original

mix at any time after the working drawings have been approved, shall be submitted, in writing to the DCES

- Proposed admixture to be added to the concrete mix
- Quality control tests and procedures
- Method and outline of unit and cylinder curing procedure, as required by “Curing”
- The name of the manufacturer of the prestressing steel, including any alternate source
- Material and manner of sealing the exposed portions of the prestressing steel
- Transfer of prestress procedure for all unit types to be fabricated
- Complete details, including anticipated camber, tensioning force (initial and final), concrete strength (transfer and 28 day), and type and location of lifting device for all prestressed concrete units to be fabricated.
- Proposed method of handling and transporting prestressed concrete units to the project site
- Working drawings shall clearly indicate any proposed deviations from the prestressed concrete unit shown on the contract drawings
- Winter concreting procedures, if need is anticipated.

**Submission of Working Drawings.** When the working drawings, prepared by the Contractor, as specified, are completed, check prints shall be submitted to the DCES, who will indicate thereon such corrections as may be necessary to secure the completion of the contract in accordance with the requirements of the contract documents. The Contractor shall submit three sets of check prints for the DCES and two additional sets of check prints for each Railroad or other Agency involved with the contract. All sets of check prints shall be submitted to the DCES, who will make the distribution to the Railroad and other Agencies involved. One set of check prints or sepias with desired corrections indicated thereon in colored crayon or pencil, will be returned to the Contractor. When the revisions have been completed to the satisfaction of the DCES, the original drawings shall be forwarded to the DCES for written approval, after which a set of approved drawings will be returned. The original drawings shall remain the property of the State.

The DCES shall be allowed two work days for the examination of each drawing in a set of working drawings, or ten work days minimum per set. A set of working drawings shall be considered to be all drawings received by the DCES from any given Contractor for a particular contract on any calendar day. If the working drawings are detained for examination for a period longer than that previously stated, such detention will be taken into account when considering application by the Contractor for an extension of time for the completion of the contract. All working drawings are time and date stamped as they are received and recorded in a log at the office of the DCES. This log shall be the basis for determining when drawings must be returned without consideration for an adjustment of the completion date as described herein.

Approval of working drawings shall not constitute approval for the following information required on the working drawings 2B(3) and 2B(7). This data is required for information only.

## **FABRICATION**

**Approval of Working Drawings.** No fabrication shall be started until after the working drawings have been approved and the Inspector has received prints made from the original drawings.

**Data Required with Working Drawings.** Data required by the DCES prior to approval of the working drawings shall be as follows:

- Calculations of strand elongation for each unique casting length (grip-to-grip)
- A calibration certificate indicating the load calibration of each gage and hydraulic jack combination used for tensioning. The gage shall be calibrated from zero, throughout its entire load range. The



gage shall have clearly marked divisions that are easily readable at the initial and final tensioning force. The calibration date of each combination gage and hydraulic jack shall be within the 12 month period immediately prior to the start of the work.

- A calibration certificate attesting to the fact that the concrete cylinder testing machine to be used has been calibrated within the 12 month period immediately prior to the first date of actual use of the machine.

**Data for Inspector.** Data required to be submitted to the Inspector for approval prior to the inclusion of the respective materials in the unit, shall be as follows:

**A. Prestressing Steel Certification.** A certificate from the prestressing steel manufacturer stating that the prestressing steel has been manufactured in accordance with '709-06.

**B. Load-Strain Curves.** Typical load-strain curves made during the processing of steel from which the elongation appropriate to the required prestressing force can be determined, including the following information:

- The breaking strength
- The elongation at rupture
- The load at one percent elongation
- The test dates

The aforesaid information shall be submitted to the Inspector, in triplicate, for each 25 ton lot, or fraction thereof, of prestressing steel.

**C. Other Certifications.** Certificates indicating acceptance of bar reinforcement, concrete materials and any other material used in the prestressed concrete unit.

**Inspection.** Fabrication of units shall be inspected by an Inspector designated by the State. The Contractor shall inform the State 72 hours prior to:

- Commencement of work
- Commencement of work after a work suspension of 48 hours or more
- Unit shipping

The Contractor shall keep the Inspector informed of the day-to-day scheduling of operations. The Inspector shall have free access throughout the fabrication plant to see that the work being done is in conformance with the contract documents. Work done while the Inspector has been refused access shall be automatically rejected. The Inspector shall be present when necessary tests are made on the prestressing steel at the place of manufacture.

## **Concrete Forms**

**A. General.** Forms shall be well-constructed, carefully aligned, clean, substantial and firm, securely braced and fastened together and sufficiently tight to prevent leakage of mortar. They shall be strong enough to withstand the action of mechanical vibrators. All forms for each unit shall be approved by the Inspector prior to placing concrete.

All form surfaces that come in contact with the concrete shall be thoroughly treated with an approved form coating in the manner and at the rate specified by the manufacturer. Forms so treated shall be protected against damage and dirt prior to placing concrete.

Any form coating material that will stick to or discolor concrete shall not be used.

**B. Void-Producing Forms.** Void forms shall be coated with a waterproofing material on the outside and shall have a 3/4 inch (nominal) diameter drain placed at each end of each void.

When units are steam-cured, all voids shall be vented.

**Reinforcement and Prestressing Steel.** Prior to installation in the units, reinforcement and prestressing steel shall be free of frost, dirt, oil, paint, mill scale, corrosion, or any foreign material that may prevent bond between the steel and the concrete.

Tack welding of bar reinforcement shall not be allowed under any circumstances.

Welded wire fabric, smooth or deformed, may be substituted for the required bar reinforcement provided that:

- The required cover is maintained
- The design steel area of the fabric equals that of the bar reinforcement
- Splices to the fabric are made in accordance with the requirements of the N.Y.S.D.O.T. Standard Specifications for Highway Bridges, ' 1.5.22D and ' 1.5.22E as applicable.

If wire fabric is used, the details shall be indicated on the working drawings. Design computations shall also be included.

**Tensioning of Prestressing Strands.** A calibrated force of 3000 pounds shall be applied initially to each strand. Consideration will be given by the DCES to a different initial force for special cases. This force shall be the starting point for additional tensioning by elongation.

For draped strands, the additional tensioning or prestressing force induced in the prestressing steel shall be measured by jacking gages and by elongation of the steel. The jacking gages shall read within 5 percent of the force theoretically calculated to be induced by elongation.

For straight strands, elongation only shall determine the prestressing force.

During tensioning of any one strand, the process shall be so conducted that the applied load and the elongation of the strand may be measured at all times.

Two copies of recorded gage pressures and measured elongations, as required for the tensioning of prestressing strands in each unit, shall be submitted to the Inspector.

The use of load cells or other tension measuring devices may be required. They shall be furnished by the Inspector and used in accordance with his/her instructions.

**Concrete Mix Design and Proportioning.** The Contractor shall be responsible for designing a concrete mix to produce the strength and other requirements specified on the contract plans. If no strength is indicated, the required minimum strength shall be 4000 psi at transfer and 5000 psi at 28 days. Maximum cement content for any proposed mix shall be 750 lb/cy. Proposed mixes shall be submitted in accordance with the requirements of Drawings, Paragraph 2B(3). Automatic proportioning equipment will not be required.

The Contractor may request permission from the DCES to incorporate a High Range Water Reducing (HRWR) admixture into the concrete mix. The DCES will grant such permission only if deemed to be in the best interests of the State and then only under such conditions as the DCES requires.

**Placing Concrete.** No concrete shall be placed without the Inspector's approval. Compliance with the precasting tolerances is a prerequisite for casting approval by the Inspector.

When the atmospheric temperature is below 40°F, the fabrication of the units shall be in accordance with the winter concrete procedures as approved on the working drawings.

Suitable means shall be used for placing concrete without segregation. The concrete mixture shall not be dropped from a height greater than 12 inches above the top of the forms. Special care shall be taken to deposit the concrete in its final position in each part of the form.

The plastic concrete shall be consolidated in place by either external or internal vibration methods, or both, if necessary. The vibrators shall be of a type and design approved by the Inspector and the size of the vibrating head will be governed by the spacing of the prestressing steel and reinforcement. Vibrators shall be used only to consolidate the concrete after it has been properly placed.

The internal vibrator shall be slowly inserted and removed from the concrete.

The following quality control tests shall be performed, by the Contractor in the presence of the Inspector from the same concrete sample as that used for the Concrete Strength Requirements of this specification:

- Slump
- Air content
- Temperature
- Unit mass.

**Finishing.** To assure production of well-formed matching beams with overall pleasing appearance, all surfaces of concrete shall be true and even, free from rough, open or honeycombed areas, depressions or projections. After all the concrete has been placed and thoroughly compacted as required under Placing Concrete, the tops of units shall be magnesium-float finished, or finished as shown on the Working Drawings. If required, all exposed surfaces shall be finished by bagging.

All exposed reinforcement shall be coated with neat cement paste prior to placement in the storage area.

**Curing.** The Contractor shall indicate on the working drawings, for approval, the method of cure and complete outline of the proposed procedure under each of the phases of the curing cycle. The full curing cycle consists of an Initial Curing Phase and Final Curing Phase. The Contractor may choose any one of the following acceptable curing methods, however only one curing method will be allowed for the units of a single structure.

To ensure complete hydration of cement, and to prevent the formation of cracks, moisture must be retained within the concrete. Therefore, immediately upon the completion of concrete placement for each unit, an enclosure shall be placed over the casting bed. The Contractor shall submit all covers for inspection prior to the commencement of work.

**A. Accelerated Cures.** Acceptable methods for accelerated cures are by application of low pressure steam or by application of radiant heat and moisture.

**1. Initial Curing Phase.** The initial curing phase for each unit shall be that period beginning from the time each unit is completely covered and continuing until the final curing phase commences.

The Contractor shall indicate the duration of the initial curing phase for each unit. However, the initial curing phase shall not exceed eight hours. During this phase, the enclosure temperature shall be maintained at approximately the concrete placing temperature; artificial heat shall be applied if necessary.

**2. Final Curing Phase.** The final curing phase for each unit shall be that period required to raise the initial curing phase temperature to the selected temperature range at a rate not exceeding 50°F per hour and continuing until the concrete has attained the minimum transfer strength as noted on

the contract plans or as noted in this specification, under the paragraph Concrete Mix Design and Proportioning, whichever is applicable.

The selected curing temperature range shall be as approved on the working drawings.

**B. Non-Accelerated Cure.** The acceptable method of non-accelerated cure is by the application of a saturated cover.

**1. Initial Curing Phase.** The requirements of A1 above, shall apply.

**2. Final Curing Phase.** The final curing phase may begin at anytime after commencement of the initial curing phase. Each unit shall be covered with heavy, water saturated burlap, or other material acceptable to the Inspector. The burlap shall be kept saturated, and the concrete surface temperature shall not drop below 68°F. These conditions shall be maintained until either of the following has occurred:

- a. Seventy-two hours have passed from the time of burlap placement; or
- b. Minimum transfer strength has been reached.

**Record of Curing Time - Temperature.** The Contractor shall provide one (1) automatic temperature recorder for every 100 feet of casting bed. The recorder shall continuously record curing temperatures for the initial and final curing phases. Temperature sensors shall be carefully placed within the curing enclosure to ensure that ambient temperatures are measured at the designated locations. Recorder accuracy shall be certified once every 12 months and the certificate displayed with each recorder. In addition, random temperature checks of each recorder shall be made by the Inspector.

Each temperature chart shall indicate the casting bed, date of casting, time of commencing graphic plot and units represented by chart. The start of artificial heat and the transfer of prestress shall be indicated on each graphic record.

After completion of the final curing phase, the charts shall be properly marked and given to the Inspector. Temperatures recorded on the charts shall be considered as verification of whether the units have been cured in accordance with the approved working drawings.

**Transfer of Prestress.** Transfer of prestress shall be accomplished as soon as the final curing phase is complete.

### Concrete Strength Requirements

**A. Test Cylinders.** The concrete strength shall be determined from concrete test cylinders made in conformance with ASTM C31, except that all cylinders shall be vibrated. All cylinders shall be tested in conformance with ASTM C39, on an approved testing machine. All cylinders shall be made and tested by the Contractor in the presence of the Inspector.

The cylinders shall be made from concrete actually placed in the units. The Inspector shall be the sole judge of which cylinders are defective or damaged and are not to be included in the determination of the strength class. Test cylinders used to determine required strengths for detensioning shall be cured as specified on the working drawings.

All cylinders used to test for concrete strength shall be cured in the same manner as the units they represent unless otherwise indicated on the working drawings.

The Contractor shall cast a sufficient number of concrete test cylinders to fulfill the concrete strength test requirements as stated in 2 below. This testing procedure may be altered by the DCES. If an alternate procedure is to be followed, it shall be indicated on the contract drawings. The number of test cylinders to be cast for each unit shall be shown on the working drawings.

**B. Testing for Concrete Strength.** The strength requirements for each unit shall be certified by the Contractor, as follows, before the unit is accepted for strength:

**1. Transfer Strength.** Two cylinders from each unit shall be tested in immediate succession to verify prestress transfer strength. One of the two cylinders tested to determine the strength of the last unit cast in any bed shall be taken from the last batch of concrete placed in that unit. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the two cylinders shall be equal to or greater than the required prestress transfer strength.

**2. 28 Day Strength**

a. Two cylinders from each unit shall be tested in immediate succession at 28 days of age to verify the required 28 day strength of the concrete. The average strength of the two cylinders shall be equal to or greater than the required 28 day strength. If this requirement is not met, any remaining cylinders representing the unit shall be tested at 28 days of age. The average strength of all cylinders representing the 28 day strength of any one unit shall be equal to or greater than the required 28 day strength.

b. The Contractor may elect to test two cylinders from each unit in immediate succession, prior to the 28 day age limit. If this option is exercised sufficient cylinders shall be made to ensure that at least two cylinders are available for the 28 day test. Each cylinder shall have a strength of at least 95 percent of the required 28 day strength. The average of the two cylinders must be equal to or greater than the required 28 day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived.

**Rejection of Units.** Any unit not fabricated in accordance with the contract documents or displaying any of the following defects shall be subject to rejection:

**A. Strength Requirement.** Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements.

**B. Exposed Prestressing Steel.** Any unit that has one (1) prestress strand exposed in excess of 24 diameters, or two (2) or more exposed strands.

**C. Honeycombing.** Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the conditions described in the above paragraph 2, Exposed Prestressing Steel.

All honeycombed areas in a unit must be chipped until sound concrete is detected. Sound concrete is defined as that point at which chipping causes fracture of the aggregates.

**D. Stress Cracks.** Any unit that has a stress crack in the area beginning 4 inches from the unit end to the center line of the unit that is greater than 1/2 inch in depth and 2.5 mils in width.

**E. Injurious Materials.** Materials used for the manufacture of concrete shall not contain, nor cause concentration of, chemicals, or other materials injurious to concrete.

Concentrations of total chloride ions in excess of 0.05% by mass of cement are considered injurious.

Other material and concentration injury potential will be determined by the D.C.E.T.S. according to Department written instructions.

**Damaged units.** The Inspector shall determine whether spalled, honeycombed, or otherwise defective concrete shall be repaired or be subject to rejection. The decision to repair a unit or reject a unit shall require the concurrence of the DCES.

**Removal of Unsuitable Material.** Prior to beginning the repair, all spalled, honeycombed or disintegrated concrete shall be removed by chipping the unsuitable material away until sound concrete is reached. Sound concrete shall be as defined under Rejection of Units, Subparagraph 3. Chipping tools shall be pneumatic. The type and size of tools and the depth at which sound concrete is reached shall be determined by the Inspector.

**Blast Cleaning Surfaces.** All surfaces to be repaired shall be thoroughly blast-cleaned with No. 40 boiler slag grit or No. 2 sandblast sand, or as ordered by the Inspector.

**REPAIR.** Repair shall be designated as “structural repair” or “nonstructural repair” by the Deputy Chief Engineer (Structures). Repair to a unit shall be done in accordance with the following.

**Structural Repair.** Repair, designated as “structural” by the DCES, shall be made with an epoxy grout comprised of an epoxy resin system (721-01), or an epoxy polysulfide grout (721-03), mixed with fine aggregate. The grout shall be mixed and placed in accordance with the following:

**A. Mixing.** No mixing shall be started until all preparations have been made to use the grout. The Contractor shall be familiar with the pot life limitations of the epoxy being used, and its operations shall be governed accordingly. Mixing shall be carried out in strict accordance with the manufacturer's instructions and the following:

- Mixing shall be done as close as possible to the portion to be repaired.
- All necessary equipment for mixing and placing shall be present at the site, and in good working order, prior to the start of mixing.
- The grout shall be proportioned by volume in the approximate ratio of two (2) parts fine aggregate to one (1) part epoxy. The exact ratio of sand to epoxy resin system shall be determined on-site to produce a dense void-free grout.
- Dry, fine aggregate shall be placed in the mix container first. It shall be thoroughly agitated prior to the addition of the epoxy.
- The two components of the epoxy system shall be thoroughly mixed together before being added to the fine aggregate.
- The epoxy shall be added to the fine aggregate slowly, but mixing time shall not exceed three minutes.
- All grout, in any individual batch, shall be used within 25 minutes after the start of mixing of the two components to create the epoxy system. All grout not used within the time limit shall be discarded.
- The epoxy grout shall not be retempered.

**B. Placing.** The epoxy grout shall be placed against a clean, primed, receiving surface, in accordance with the following:

- The receiving surface shall be cleaned of all oil, grease, or other material which may prevent effective bond, immediately prior to priming the surface with neat epoxy (epoxy without aggregate).
- The priming of the receiving surface shall be done immediately prior to the placement of the epoxy grout.

- The epoxy grout shall be placed quickly and continuously. It shall not be overworked.
- The temperature of the receiving surface shall be above 50°F at the time of grout placement.
- Grout placement shall not be permitted when ambient temperatures are 50°F or lower, unless methods of protection, acceptable to the Inspector, are employed. Methods of protection, if permitted, shall be continued for a period of 15 hours following grout placement. The 15 hour period may be shortened, at the discretion of the Inspector, but under no circumstances will it be less than 12 hours. Methods of protection, if permitted, are conveniences granted by the State. As such, they are not considered extra work, and therefore they are not entitled to extra compensation.
- Upon completion of grout placement, the new surface of the repaired area shall be flush with the adjacent surfaces, unless the design of the unit specifically requires otherwise.
- On surfaces which will be exposed to view after installation, the repaired area shall be color matched to the adjacent surfaces by use of cement dust, or other means acceptable to the Inspector.

**Nonstructural Repair.** Repair, designated as “nonstructural” by the DCES shall be made with either of the following:

- Epoxy grout composed of 721-01 Epoxy Resin System or 721-03 Epoxy Polysulfide Grout, and fine aggregate; or,
- 721-05 Epoxy Repair Paste.

The Contractor has the choice of materials.

**A. Mixing.** Epoxy grout shall be mixed in accordance with the requirements of A. Mixing as given under Structural Repair.

Epoxy repair paste shall be mixed in strict accordance with the manufacturer's instructions.

**B. Placing.** Placing of either material shall be done in accordance with the requirements of B. Placing as given under Structural Repair.

**TOLERANCES.** Tolerances of the Prestressed Concrete Units shall meet the requirements specified in the Contract Documents.

Units which fail to meet the tolerances shall be rejected with the concurrence of the DCES.

**SHIPPING.** Units shall not be shipped until the minimum 28 day strength has been attained, but in no case, before 72 hours' storage time has elapsed following transfer of prestress.

**BASIS OF ACCEPTANCE.** The Inspector's stamp of approval shall constitute the basis of acceptance for shipment to the job site. The Inspector's stamp shall be placed on the unit after loading for shipment.

Application of the Inspector's acceptance stamp indicates that at the time of shipment, it was the Inspector's opinion that the unit was fabricated from accepted materials, by approved processes, and was properly loaded for shipment.

Such application does not imply that the material will not be rejected by the State if it is subsequently found to be defective.

## **718-02 THRU 718-04 (VACANT)**

## **718-05 PRESTRESSED CONCRETE FORM UNITS**

**SCOPE.** This specification contains the requirements for prestressed concrete form units. These units are used to form the lower portion of a structural slab. They act compositely with the cast-in-place portion of the slab and become an integral part of the structural slab.

**GENERAL.** 718-01 Prestressed Concrete Units (Structural) shall apply except for the following modifications to the FABRICATION, REPAIR and TOLERANCES:

**FABRICATION.** 718-01 shall apply except as follows:

**Reinforcement and Prestressing Steel.** 718-01 shall apply. In addition, devices which will be used as hold-down points for outside reinforcing steel shall be placed prior to concrete placement in the forms. Devices used to lift the units are acceptable for this purpose. The maximum spacing between hold-down devices shall be 4 feet center-to-center of device.

**Finishing.** 718-01 shall apply except the tops of units do not have to be magnesium float finished.

**Concrete Strength Requirements.** 718-01 shall apply except the testing shall be as follows:

**Testing for Concrete Strength.** The strength requirements for each day's production shall be certified by the Contractor before that day's production is accepted for strength. Certification shall be done in accordance with the terms of this subsection. All cylinders cast shall be cast in sets of three. One set shall be cast from the first concrete placement of the day. One set shall be cast from the last concrete placement of the day. In addition to those, there shall be a set cast for each 15 cubic yards of concrete, or major fraction thereof, placed in any one day.

**1. Transfer Strength.** Three cylinders from each day's production shall be tested in immediate succession to verify prestress transfer strength. One cylinder shall be taken from the first set cast; one cylinder shall be taken from the last set cast. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the three cylinders shall be equal to, or greater than, the required prestress transfer strength.

**2. 28-Day Strength.** Three (3) cylinders representing each day's production shall be tested in immediate succession at twenty-eight (28) days of age to verify the required 28-day strength. The strength of each cylinder shall be at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are not met, any remaining cylinders representing the day's production shall also be tested at 28 days of age. The average strength of all cylinders representing the 28-day strength of any one day's production shall be equal to, or greater than, the required 28-day strength.

**3. Option.** The Contractor may test three (3) cylinders, representing each day's production in immediate succession, prior to the 28-day age limit. Each cylinder shall have a strength of at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived. If this option is exercised, sufficient cylinders shall be made to ensure that at least 3 cylinders are available for the 28-day test.

**Rejection of Units.** Any unit not fabricated in accordance with the Contract Documents, or displaying any of the following defects, shall be subject to rejection:



**A. Strength Requirements.** Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this specification.

**B. Exposed Prestressing Steel.** Any unit which exhibits one or more exposed prestressing strand(s) on a top or bottom surface.

**C. Honeycombing.** Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the exposure of one, or more, prestressing strands on a top, or bottom, surface.

All honeycombed areas shall be chipped until sound concrete is reached. Sound concrete is defined as that point at which chipping causes fracture of the aggregates. If chipping of the honeycombed portion results in a hole more than one-half the thickness of the unit, the unit will be rejected.

**D. Cracks.** Any unit which exhibits a crack that is greater than 1/2 inch in depth, and 2.5 mils in width.

**REPAIR.** Repair, if allowed by the DCES, shall be made with 721-05 Epoxy Repair Paste. Epoxy repair paste shall be mixed and placed in strict accordance with the manufacturer's instructions.

**Form Supports** Form supports for installation of the units shall be supplied as part of this work. They shall conform to the latest specification for ASTM A446, Grades A through E. Fabrication shall be in conformance with ASTM A653/A653M, Coating Class G165.

The Contractor shall supply the Engineer with certification that the form supports meet the foregoing requirements.

**TOLERANCES.** All units shall be checked for compliance with the tolerances listed below, after the units have completed the final curing phase and within three (3) days prior to shipping. The Inspector shall document to the DCES any unit with dimensions out of tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES.

**Finished Dimensions**

\*Width  $\pm$  1/4 inch

Length  $\pm$  1/2 inch

Depth  $\pm$  1/4 inch

\*Width is defined as the dimension measured parallel to the prestressing strands.

**Position of Strands**

Vertical  $\pm$  1/4 inch

Horizontal  $\pm$  1/2 inch

**718-06 HIGH PERFORMANCE CONCRETE FOR PRECAST AND PRESTRESSED BRIDGE BEAMS**

**SCOPE.** This specification covers the material requirements for high performance concrete for precast and prestressed bridge beams.

**MATERIAL REQUIREMENTS.** The concrete shall meet the requirements of the approved Mix Design Sheet, described below, and the PCCM. The concrete mix shall contain a minimum of 5% microsilica measured as a percent of the total cementitious material.

**MIX DESIGN SHEETS (MDS).** These sheets shall contain all the information on the mix design, materials, material sources, production facilities, quality control, curing, and preproduction testing of the mix. Once approved for production, the MDS may be used in any contract requiring high performance concrete for precast and prestressed bridge beams.

The MDS will have a two-step approval process. The first submittal shall contain all the information required in A. through N. Complete submittals that meet the specification requirements will be examined according to Section 2.5 of the PCCM and, if found acceptable, it will be returned with the notation “APPROVED FOR TESTING.” Section 2.5.7 of the PCCM does not apply.

Following required testing of the mix, the MDS shall be submitted to the DCES with the information in O. through Q. added to the sheet. If the test results meet the requirements of this specification, the MDS will be returned with the notation “APPROVED.” After approval for production, no changes in materials sources, production, curing, or mix design shall be made, except those changes necessitated by a change in the fineness modulus of the aggregate.

If changes are required after the approval of the MDS, a revised MDS with all the required changes shall be submitted to the DCES. After examining the revised MDS, the DCES will determine if repetition of any testing is required for the approval of the revised MDS. If it is determined that some or all tests shall be repeated, the revised MDS will be returned marked up, specifying the required tests to be repeated and stamped “APPROVED FOR TESTING.” Remaining portions of the approval process will exactly follow the procedure used for the initial approval of the MDS except that the tests to be performed will be limited to the tests to be repeated marked up by the DCES.

If it is determined that there is no need for repeating the preproduction testing and if the proposed changes are acceptable to the DCES, the revised MDS will be approved and returned.

**Information Required on MDS.** The MDS shall include the following information:

- A. The source and type of cement.
- B. The specific source of the coarse aggregate.
- C. The specific source of the fine aggregate and the fineness modulus of the material proposed for use in the preproduction testing.
- D. The brand and type of all admixtures that will be used.
- E. The complete mix design including all ingredient and quantities proposed for the production concrete.
- F. The maximum water-to-total-cementitious-material ratio that is proposed for production.
- G. Description of the concrete batching and mixing facilities, including the date of last annual inspection and date of last scale calibration check.
- H. Description of the concrete transport equipment.
- I. The method of concrete placement.
- J. Outline of the curing procedure to be used for the production units and test samples.
- K. Quality control tests and procedures that the fabricator will perform.
- L. Detailed description of the preproduction testing procedure to establish that concrete made from the proposed mix design meets the required performance criteria.
- M. The name and address of the testing laboratory(s) conducting the tests.
- N. A fabricator selected identifier for the mix.
- O. Test results for the preproduction test mix.
- P. Actual fineness modulus of the fine aggregate used in the preproduction test mix.
- Q. Graph of compressive strength versus age.

**TESTING.** The concrete mix design shall be tested prior to making any bridge beams and shall meet the following performance criteria.

<b>TABLE 718-06-1 TESTING REQUIREMENTS FOR HP CONCRETE</b>		
<b>PROPERTY</b>	<b>TEST METHOD</b>	<b>ACCEPTANCE CRITERIA</b>
Compressive Strength (at 56 days)	AASHTO T22	> 10,000 psi (all tests)

Freeze/Thaw Durability (x=relative dynamic modulus of elasticity after 300 cycles)	AASHTO T161 Procedure A	$x \geq 80\%$
Scaling Resistance (y= visual rating of surface after 50 cycles)	ASTM C672	$y \leq 3$
Elasticity (E = modulus of elasticity)	ASTM C469 (Note C)	$E \geq 4.35 \times 10^6$ psi
Shrinkage (s= microstrain)	AASHTO T160-97 (at 56 days)	$s < 600$
Creep (c = microstrain/pressure unit)	ASTM C512(at 56 days, 40% fc')	$c \leq 414/$ ksi
Chloride Penetration (p= increase in percent of chloride ion by weight of concrete)	AASHTO T259 modified (Note A)	$p \leq 0.025\%$ at 1 inch
Air Content	AASHTO T 152	A = % selected by contractor, $A \geq 3\%$
Water/Cementitious-Materials ratio (W= mass ratio)	AASHTO TP23-93 (Note B)	Supplier selects W, $W < 0.40$

Note A: The test specimens are to be cured under the same conditions and for the same time as proposed for production. They shall then be stored for 28 days in the drying room specified by the AASHTO T259.

Note B: The AASHTO TP23 test shall be corrected for the absorbed water in the aggregate. This correction shall be made using the mass percentage of absorption shown under "ABS" in the Approved List of Sources of Fine and Coarse Aggregates (or as determined by AASHTO T-84 for fine aggregates and AASHTO T-85 for coarse aggregate) by an AASHTO accredited testing laboratory.

Note C: Test two samples. Each sample is to be loaded at 40% of the load required to break a companion sample cast from the same mix at the same time as the test sample. Sample 1 is to be loaded when the strength of a companion sample achieves a strength of  $7000 \pm 430$  psi. Sample 2 is to be loaded when the strength of a companion sample achieves a strength of  $10,000 \pm 860$  psi.

## PREPRODUCTION TESTING

The Contractor shall engage an AASHTO Accredited testing laboratory for testing of all preproduction concrete specimens except compressive strength, air content, and water/cementitious-materials ratio. These tests shall be performed in the presence of the Quality Assurance (QA) Inspector. The DCES may approve laboratories with equivalent certification from another organization. The testing laboratory shall send a copy of the test results directly to the DCES.

The Contractor shall notify the Department at least three work days prior to casting preproduction test specimens. No test specimens shall be cast unless the QA Inspector is present to witness the mixing, casting, and curing of the specimens. The test specimens shall be prepared of concrete made using materials from sources shown on the "Approved For Testing" MDS.

The water-to-total-cementitious-materials ratio for concrete mix for purposes of preparing specimens for chloride penetration testing shall be 0.03 higher than the maximum water-to-total-cementitious-materials ratio that is proposed for production. In addition to those specimens needed for AASHTO T259 testing, the fabricator shall cast eighteen 4 x 8 inch cylinders from the chloride penetration test mix, cure the cylinders in accordance with the approved production curing procedures for long-term independent testing and research. These cylinders shall be delivered to the testing laboratory designated by the DCES.

The test mix for all other tests shall be the water-to-total-cementitious-materials ratio that is proposed for production within a tolerance of 0.01. Include the total aggregate moisture, as determined according to AASHTO T 255, in the calculation of the water-to-total-cementitious-materials ratio with appropriate adjustments. (See Note B in Material Requirements.)

Using the test mix, cast and test compressive strength cylinders at 18 hours, 3 days, 7 days, 28 days, and 56 days. Present the test results in a graph.

**Acceptance of Test Specimens.** All test specimens shall be prepared in accordance with an "Approved for Testing" MDS. The preparation, casting, and curing of the test specimens shall be done in the

presence of the QA Inspector. The QA Inspector shall indicate the procedures on the MDS were followed by affixing the inspection agency stamp on the samples prior to shipping to the Independent Testing Laboratories.

**FABRICATION.** The requirements of the PCCM shall apply with the following modifications:

1. Submitted Shop Drawings shall include approved Mix Design Sheets.
2. The required 56-day strength is 10,000 psi, unless shown otherwise in the Contract Documents.
3. The required minimum strength for imparting prestressing force into the concrete is 7000 psi unless shown otherwise in the Contract Documents.
4. The fineness modulus of the fine aggregate shall not vary more than 0.2 from the actual fineness modulus used in the preproduction test mix.
5. Water/Cementitious-materials ratio shall be measured by the Fabricator for the first batch of concrete in a day's placement and monitored by slump tests throughout production. If the QA Inspector has reason to believe the water/cementitious-materials ratio is changing, or if the slump increases by more than the allowed increase in the table below, additional water/cementitious-materials ratio tests may be ordered.

<b>Slump of First Batch</b>	<b>Allowed Increase</b>
Less than 4 inches	1 inch
4 inches or more	1 1/2 inch

6. Batch tickets shall be provided to the Inspector to verify the concrete mix contents.

**BASIS OF ACCEPTANCE.** Units will be considered for acceptance at the manufacturing location in accordance with the PCCM.

### **718-07 DIAPHRAGMS FOR PRESTRESSED CONCRETE BEAMS**

**SCOPE.** This specification covers the material requirements for diaphragms used with prestressed concrete beam spread systems. Diaphragms may be cast-in-place concrete, precast concrete, or steel.

**MATERIAL REQUIREMENTS.** Diaphragms shall meet the requirements of the PCCM, and the following:

- A. Cast-in-place concrete shall meet the requirements for Class HP concrete. Damaged or defective concrete shall be defined by and repaired in accordance with the requirements of §555-3.11, Damaged or Defective Concrete.
- B. Steel Diaphragms.
  - a. Steel shall meet the requirements of §715-01. Stock steel is allowed.
  - b. All steel shall be galvanized in accordance with §719-01.
  - c. Fabrication and transportation shall follow the requirements of the SCM.
  - d. Shop drawings shall be submitted as part of the complete package of prestressed concrete beam drawings.
  - e. Erection shall follow the requirements of the SCM, except that the erection drawings will be included with the erection drawings for the concrete beams and shall follow the approval procedure in the PCCM.
  - f. Shop inspection may be performed at the discretion of the Department.
  - g. All steel-to-steel connections shall meet the requirements of the SCM.
  - h. Bolts in steel-to-concrete connections shall be snug tight only.

**BASIS OF ACCEPTANCE.** Steel diaphragms will be accepted by the Engineer in accordance with the requirements of 715.01. Precast diaphragms will be accepted in accordance with the requirements of the PCCM. Cast-in-place diaphragms will be accepted by the Engineer.

**718-08 THRU 718-29 (VACANT)**

**718-47 FOR SITE MANAGER USE**

**718-50 THRU 718-53 FOR SITE MANAGER USE**

**718-61 FOR SITE MANAGER USE**

**718-66 FOR SITE MANAGER USE**

**718-96 FOR SITE MANAGER USE**

**718-99 FOR SITE MANAGER USE**

## **SECTION 719 - METAL COATINGS**

### **719-01 GALVANIZED COATINGS AND REPAIR METHODS**

**SCOPE.** These specifications cover the galvanized coatings applied to various materials and the repair thereto.

**MATERIAL REQUIREMENTS.** Materials shall be galvanized in accordance with the specification indicated by Type on the plans or in the specifications.

**Type I.** ASTM A123 Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.

**Type II.** ASTM A153, Zinc Coating (Hot Dip) on Iron and Steel Hardware. As an alternate to the hot dip method of ASTM A153, nuts, bolts, washers and other miscellaneous hardware, approved by the Engineer, may be mechanically galvanized. The mechanically zinc-coated product(s) shall conform to the applicable coating thickness, adherence and quality requirements of ASTM A153. Mechanically zinc-coated nuts for assembly with mechanically zinc-coated bolts shall be tapped oversize prior to coating and need not be re-tapped afterwards.

**Type III.** ASTM A123 Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products, except as modified herein. A minimum weight of coating (oz/ft<sup>2</sup> of surface) for base metal less than 1/16 inch thickness shall be as follows:

<b>Average of Specimen</b>	<b>Any Individual Specimen or Computed Value</b>
1.5	1.25

**Type IV.** ASTM A653/A653M, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, Coating Designation G 210 unless otherwise specified.

**Type V.** Flame Sprayed Coating System.

**A. Preparation of Base.** Those areas to be coated shall be sand blasted with silica sand or crushed garnet of such gradation that sand shall be mesh size 20 to 40 with a minimum of 40% retained on a No. 30 mesh screen (U.S. Standard Sieve series). Pressure of not less than 75 psi shall be maintained at the blast generator. A sample steel plate shall be blasted until the surface cannot be further cleaned or roughened. This plate shall be used for visual comparison and any areas that do not meet this standard as to roughness or cleanliness shall be reblasted.

**B. Zinc Application.** The wire used in spraying shall be 15 ga., 1/8 inch or 3/16 inch diameter, zinc 99.0% purity. Air pressure at the Air Control Unit shall be 60 psi and there shall be no more than 35 feet of 3/8 inch I.D. hose between the Air Control Unit and the gun.

The metal coating shall be applied at a minimum thickness of 3 mils. At least one coating shall be applied within 4 hours of blasting and the surface must be completely coated within 8 hours of blasting. The specified thickness of coating shall be applied in multiple layers and in no case shall less than two passes be made over every part of the surface.

**C. Finish Coat.** The zinc coating shall be given a finish coating consisting of two coats of Aluminum Vinyl sealer. This sealer shall consist of a volatile vehicle containing a minimum of 20% Vinyl Copolymer and plasticizer and a minimum of 10% Non-Leafing Aluminum Flake.

**REPAIR.** The Contractor shall be required to repair damaged areas of galvanized zinc coating. Damage may result from wet storage (white rust), welding or cutting (flame), or from excessive rough handling during shipping or erection. In general, only field repairs will be allowed. Shop repairs shall only be permitted when the total area of damage on any single piece is less than 2% of the coated surface or 16 square inches, whichever is less. Any coated piece on which the total area of damage exceeds these amounts in the shop shall be rejected.

Materials for field repair shall be selected from Department's Approved List of Galvanized Repair Materials. Zinc solders shall be zinc-cadmium and zinc-tin-lead alloys supplied in stick or paste form, and that liquidize for application at temperature ranges of from 518 to 527°F and 446 to 500°F, respectively. Zinc paints shall contain not less than 65% zinc dust (by weight) in the dried paint film and shall meet current standards for the emission of volatile organic compounds. Detailed requirements for the approval of galvanized repair materials are available from the Materials Bureau.

Corrosion deposits shall be removed in a manner satisfactory to the Department prior to incorporation of the material in the work. After removal of these deposits, the coating shall have a uniform appearance free from uncoated spots, lumps, blisters, gritty areas, acid, flux and black spots. Materials with these defects will be rejected and shall be immediately removed from the worksite. Acceptable material shall be provided to replace rejected material at no additional expense to the State.

Damaged areas of loose and deteriorated galvanized zinc coating shall be cleaned by power sanding, power grinding, or abrasive blast cleaning to bright metal.

If zinc solder is used for repairs the cleaned area shall be preheated in accordance with the manufacturers instructions for use. The heated surface shall then be rubbed with a repair stick to evenly distribute a layer of zinc alloy, or if zinc paste is used it shall be spread evenly using a spatula or similar tool. Zinc solder shall be deposited in a uniform layer at a minimum dry film thickness of 3 mils.

If zinc paint is used for repairs it shall be applied in accordance with the manufacturers instructions for use, using a brush or by spray methods. Zinc paint shall be applied in such quantity as to produce a minimum dry film thickness of 3 mils.

**BASIS OF ACCEPTANCE.** The acceptance of galvanized coating and repairs is included in the acceptance of the materials receiving the coating.

## 719-02 ALUMINUM ANODIC COATINGS

**SCOPE.** This specification covers the material requirements for Anodic Coatings for Aluminum and Aluminum Alloys.

<b>TABLE 719-02-1 MINIMUM COATING THICKNESS AND WEIGHT</b>				
<b>Coating Designation</b>	<b>Sealed with</b>	<b>Minimum Coating Thickness, mil</b>	<b>Minimum Coating Weight (mg/in<sup>2</sup>)</b>	
			<b>Alloys 1100, 3003, 5052, 5005, 5357, 5457, 6463, 6563, 6061, 6063</b>	<b>Alloys 2014, 2024</b>
Type 202	Boiling water	0.3	14.0	7.0
Type 302	Nickel Acetate	0.3	14.0	---
Type 204	Boiling water	0.4	21.0	11.0
Type 205	Chromate	0.2	---	---
Type 210	Chromate	0.4	---	---
Type 215	Boiling water	0.8	40.0	17.0
Type 226	None required	2.0	86.0	66.0

**MATERIAL REQUIREMENTS.** Anodic coatings for Aluminum and its alloys shall conform to the requirements of Table 719-02-1 for the coating designation shown on the plans or in the proposal:

### **719-03 ALUMINUM COATING (HOT DIP)**

**SCOPE.** This specification covers the material requirements for hot dip aluminum coatings applied to steel appurtenances in contact with aluminum surfaces, or where applied as shown on the contract plans.

**MATERIAL REQUIREMENTS.** The material used shall be 99 percent pure aluminum conforming to the specifications for Aluminum Alloy Number 1100 according to ANSI H 35.1.

Thickness of the coating shall not be less than 2 mils on any individual specimen and the average of the specimens tested shall not be less than 2.3 mils. The thickness of coating may be determined by the use of a Magna-Gage.

The aluminum coating on threads, except on topped threads, shall not be subjected to a cutting, rolling, or finishing tool operation, unless specifically authorized by the Engineer.

The coating shall be continuous and uniform in thickness. The coating shall adhere tenaciously to the surface of the base metal. When the coating is cut or pried into, such as with a stout knife applied with considerable pressure in a manner tending to remove a portion of the coating, it shall only be possible to remove small particles of the coating by paring or whittling, and it shall not be possible to peel any portion of the coating so as to expose the steel.

The aluminum coated articles shall be free from uncoated spots and other defects not consistent with good aluminum coating practice.

### **719-99 FOR SITE MANAGER USE**

## **SECTION 720 - PILES**

### **720-01 UNTREATED TIMBER PILES**

**SCOPE.** This specification covers the material requirements for untreated timber piles.

**GENERAL.** Timber piling shall consist of any species of wood that will withstand driving, except white or gray birch, poplar or basswood.

Piles shall be clean-peeled and shall conform to the requirements of ASTM D25.

**BASIS OF ACCEPTANCE.** The inspector's indelible stamp of approval shall constitute sufficient basis of acceptance at the job site.

## **720-02 TREATED TIMBER PILES**

(Last Revised September, 2021)

**SCOPE.** This specification covers the material requirements for treated timber piles.

**GENERAL.** The requirements for treated timber piles shall conform to the applicable provisions of §720-01 Untreated Timber Piles with the following additions and modifications:

- Piles shall be Southern Yellow Pine or Douglas Fir containing a minimum thickness of sapwood of not less than 1 1/2 inches in Southern Yellow Pine and not less than 1 inch of Douglas Fir at the butt ends.
- Piles shall be peeled clean of bark, including the inner bark, soon after cutting, so that the piles are smooth and clean. Care shall be taken to remove as little sapwood as possible in the bark peeling operation.

The preservative used in the treatment of piles shall conform to §708-31 Wood Preservative-Water Borne, or §708-32 Wood Preservative Oil-Borne.

**CONDITIONING AND TREATMENT.** The conditioning before treatment and the preservative treatment shall conform to the requirements of American Wood Protection Association Standard U1-20, Commodity Specifications E (round timber piling) and G (marine/saltwater applications).

**INSPECTION OF PILES.** The Contractor shall give the Department ample notice relative to the location of, and time when treating operations will take place. Inspection of piles will be made by inspectors designated by the Department, before, during and after the piles are treated at the treatment plant. No piles shall be shipped which do not bear, in legible form, the inspector's stamp of approval.

The piles shall be subject to inspection by the Engineer after arrival at the site and no previous approval at the plant shall bar rejection in the field for injury, breakage, or defects discovered after the piles have left the treatment plant. Piles shall be free from damage or defects which would impair their usefulness or durability for the purpose intended. The use of irons or other devices for repairing or preventing checks, splits, or other defects will not be permitted.

**STORAGE AND HANDLING.** All treated timber piles shall be carefully handled and properly stored. Any surface breaks which do not warrant the rejection of the pile shall be treated in accordance with AWP A M4 with the addition that at least three coats of preservative shall be applied.

**TREATMENT OF PILE HEADS AND BOLT HOLES.** The heads of piles shall be treated as follows: The sawed surface and all bolt holes bored subsequent to treatment, shall be treated in accordance with AWP A M4. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

The Contractor shall document regulatory compliance by obtaining and providing copies of any necessary permits pertaining to the purchase and field application of wood preservatives from the U.S.



Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC), to the Engineer.

**BASIS OF ACCEPTANCE.** The Inspector's indelible stamp of approval shall constitute basis of acceptance at the job site.

### **720-03 CASINGS FOR CAST-IN-PLACE CONCRETE PILES**

**SCOPE.** This specification covers the material requirements for casings used for cast-in-place concrete piles.

**GENERAL.** When the diameter and thickness of pipes are shown on the plans, the material used shall conform to the requirements of ASTM A252, Grade 2, unless otherwise specified. The Contractor will be required to furnish the Engineer with two certified copies of the records of the physical tests performed on the newly manufactured pipe in accordance with the above ASTM requirements. In addition, a manufacturer's statement of certification, which explicitly verifies that the material and workmanship comply with the current ASTM standards for ASTM A252, Grade 2, must accompany each heat.

**Thickness Requirements.** The metal of shells which are directly driven shall have a thickness sufficient to withstand the driving without fracture or failure, but in no case shall the thickness be less than 0.1053 inch. Shells driven with a mandrel shall have a thickness not less than 0.0538 inch.

Pipes shall have a thickness sufficient to withstand driving without fracture or failure but in no case shall the thickness of pipes be less than 3/16 inch unless otherwise shown on the plans.

**BASIS OF ACCEPTANCE.** The manufacturer's certification shall constitute sufficient basis of acceptance at the job site.

### **720-04 STEEL H-PILES**

**SCOPE.** This specification covers the material requirements for steel H-Piles.

**GENERAL.** All steel H-Piles shall be rolled HP sections of standard dimensions. Steel for bearing piles shall be new and unused and shall conform to the requirements of 715-01 *Structural Steel*. Stock steel may be used.

**BASIS OF ACCEPTANCE.** Material acceptance will be by material certification. The certifying statement must accompany each heat and must verify that the material and workmanship comply with the current ASTM standards for ASTM A709 Grade 50, or A992 Grade 50. Two copies shall be furnished to the Engineer. *Buy America requirements apply.*

### **720-05 PILE SHOES**

**SCOPE.** This specification covers the material requirements for pile shoes.

**GENERAL.** The pile shoes shall consist of ASTM A36 steel or equivalent material capable of withstanding driving without excessive deformation.

**BASIS OF ACCEPTANCE.** Approval by the DCES shall constitute acceptance.

## 720-06 MECHANICAL PILE SPLICES

**SCOPE.** This specification covers the requirements for mechanical splices for steel H-Piles.

**GENERAL.** Steel used in the mechanical pile splices shall meet the requirements of §715-01 *Structural Steel*.

**BASIS OF APPROVAL.** The material will be evaluated for conformance with the material requirements, and product samples may be required to be submitted for testing.

Manufacturers may submit their product for evaluation to the DCES. The submission shall include copies of installation drawings, specifications, welding procedures meeting the requirements of the Steel Construction Manual, engineering calculations, test results, and quality control procedures for the splice manufacturer.

Stamped engineering calculations, performed by a New York State Licensed Professional Engineer with current registration, shall show that the spliced pile has a theoretical bending capacity of at least 95% of the unspliced pile.

Test results by an independent testing agency shall show that the bending strength on both the strong and weak axes of the spliced pile is at least as great as the calculated capacity of the splice. The tests shall be third point loadings of a spliced pile with the splice in the middle of the span. The tests shall be continued to failure. A minimum of two pile sizes shall be tested in each direction to prove the engineering calculations.

If the submission is acceptable, the installation drawings will be stamped approved, returned to the manufacturer and the product will be placed on the Approved List. Any changes to the product, product manufacturing, or installation procedure will require re-submission and re-approval.

**BASIS OF ACCEPTANCE.** The Contractor shall provide the Engineer with an installation drawing approved by the DCES showing the sizes and types of welds that are required. Mechanical pile splices will be accepted based on the product appearing on the Approved List and a material certification that the supplied product has the same chemical composition and mechanical properties as the product used in the testing. *Buy America requirements apply.*

## 720-99 FOR SITE MANAGER USE

### SECTION 721 - CONCRETE ADHESIVES AND REPAIR MATERIALS

#### 721-01 EPOXY RESIN SYSTEM

**SCOPE.** This specification covers the material requirements of a two-component, rapid setting, high strength epoxy resin system for use as an adhesive and for making epoxy mortar for the repair of minor damaged areas of hardened concrete. This material should not be used when the temperature is below 40°F or when there is moisture present in any of the materials or surfaces it will be in contact with while in the uncured state.

#### MATERIAL REQUIREMENTS

**Component A.** Component A shall consist of a blend of epoxy resin, plasticizer and fillers so that when mixed with component B the mix will have the characteristics described under “Characteristics of the Mixture”.

**Component B.** Component B shall consist of an amine adduct curing agent capable of curing the epoxy system from 40°F and above when mixed according to the manufacturer's recommendations.

<b>TABLE 721-01-1 EPOXY RESIN MIXTURE REQUIREMENTS</b>			
<b>Property</b>	<b>Test Method</b>	<b>Minimum</b>	<b>Maximum</b>
Pot life for 1 pint unit, minutes	measured from time of original mixing at 75°±2°F	10	30
Viscosity, cps @ 75°±2°F	Brookfield Model RVT Spindle No. 3 @ 20 rpm	C	2,000

**Characteristics of the Mixture.** Mixture shall meet the requirements of Table 721-01-1.

**Cured Materials.** Mixed with three (3) parts by volume of Ottawa silica sand conforming to the requirements for graded standard sand in ASTM C778, the resulting mortar shall have the following characteristics after being cured at 75°±2°F for 24 hours:

<b>TABLE 721-01-2 COMPRESSIVE AND TENSILE STRENGTH</b>			
<b>Property</b>	<b>Test Method</b>	<b>Specimen size and shape</b>	<b>Min.</b>
Compressive Strength, psi	AASHTO T 106	2 in cubic	8,000
Tensile Splitting Strength, psi	NYS DOT TM 721-04 P	2 x 4 in cylinder	1,500

**PACKAGING.** All material furnished must be shipped in strong, substantial containers. The containers shall be identified as “Part A - contains epoxy resin” and “Part B - contains curing agent” and shall be plainly marked with the following information:

- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of the manufacturer
- Lot number and batch number
- Date of manufacture
- Quantity
- Date of expiration of acceptance

**SAMPLING.** Material shall be sampled and inspected at the place of manufacture or in warehouse lots as determined by the Department. Samples submitted to the Materials Bureau shall be taken as directed by the Department.

## **TESTING**

**Pot Life.** The pot life shall be determined as follows: The mixed components shall be set on a bench top and probed with a small flat stick every two (2) minutes. The time at which a soft ball forms in the center of the container is the pot life.

**Initial Viscosity.** Components A and B shall be conditioned at 75°±2°F prior to mixing and the reading taken two (2) minutes after mixing. The viscosity shall be measured with a Brookfield Model RVT viscometer, spindle No. 3 at 20 rpm.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at manufacture or supply locations in accordance with procedural directives of the Materials Bureau. The

expiration date of acceptance of this material shall be one year after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

**721-02 (VACANT)**

**721-03 EPOXY POLYSULFIDE GROUT**

**SCOPE.** This specification covers the material requirements of a two-component, flexible, polysulfide modified epoxy grout containing an inert mineral filler. This material is used for bonding fresh concrete to hardened concrete in both vertical and horizontal planes; grouting studs, etc. into hardened concrete; and making epoxy mortar for the repair of minor damaged areas on hardened concrete. This material should not be used when the temperature is below 50°F.

**GENERAL.** The two-component epoxy system shall have a maximum ratio of epoxy resin to polysulfide polymer of 2:1 by weight (Min. 1 3/4:1). In addition, the ratio of epoxy resin to curing agent shall be 11:1 by weight (Max. 12:1, Min. 10:1). The fine inert mineral filler when incorporated into the carrying component(s) shall be nonsettling.

**MATERIAL REQUIREMENTS**

**Component A.** This component shall consist of an unmodified epoxy resin and may contain a portion of fine inert mineral filler. It shall not contain solvents or reactive diluents. The epoxy resin shall be the condensation product of the reaction of bisphenol A with epichlorohydrin, shall be translucent, and shall have the following physical characteristics:

<b>TABLE 721-03-1 COMPONENT A REQUIREMENTS</b>			
<b>Property</b>	<b>Test Method</b>	<b>Min.</b>	<b>Max.</b>
Color, Hellige	ASTM D1544	0	5
Epoxide equivalent	ASTM D1652	180	200

**Component B.** This material shall consist of a blend of a low viscosity polysulfide polymer and a tertiary amine catalyst. The “B” component shall include a fine inert mineral filler. The component shall not contain solvents or diluents. When mixed with Component “A” as directed by the manufacturer, the resulting characteristics shall be as specified in “Characteristics of the Mixture.”

The polysulfide polymer flexibilizer shall be a dichloroethyl formal polysulfide in the 1000-molecular weight range having the following characteristics:

<b>TABLE 721-03-2 COMPONENT B REQUIREMENTS</b>			
<b>Property</b>	<b>Test Method</b>	<b>Min.</b>	<b>Max.</b>
Color, Hellige	ASTM D1544	9	12
Sulphur Content, percent	ASTM D129	36	40
Shelf Life	---	1 year	---

**Characteristics of the Mixture.** When the two components are mixed in accordance with the manufacturer's instructions, the mixture shall have the physical characteristics in Table 721-03-3.

<b>TABLE 721-03-3 MIXTURE REQUIREMENTS</b>			
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Property	Test Method	Min.	Max.
Pot Life at 77°F, minutes	See TESTING	30	---
Initial Viscosity at 77°F, Spray applications Other applications	See TESTING	20 20	200 400
Tack free time at 77°F, hrs	---	2	---
Degree of temporary gelation, depth, in	See TESTING	1/8	---
Ash content, percent	ASTM D482	C	50
Volatiles, percent	ASTM D1259	1	4

**Properties of Cured Materials.** The grout, when mixed according to the manufacturer's instructions, shall harden into a solid having the physical characteristics in Table 721-03-4.

TABLE 721-03-4 CURED MATERIALS REQUIREMENTS			
Property	Test Method	Min.	Max.
Compressive Shear Double Strength, psi	Federal Specification MMM-B-350 Paragraph 4.4.3	400	---
Beam Break Test, psi	Described under "Test"	800	---

**PACKAGING.** All material furnished must be shipped in strong substantial containers. The containers shall be identified as "Part A - contains epoxy resin" and "Part B- contains curing agent" and shall be plainly marked with the following information:

- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of the manufacturer
- Lot number and batch number
- Date of manufacture
- Quantity
- Date of expiration of acceptance

**SAMPLING.** Material shall be sampled and inspected at the place of manufacture or in warehouse lots as determined by the Department. Samples submitted to the Materials Bureau shall be taken as directed by the Department.

## TESTING

**Pot Life.** The pot life shall be determined as follows: The two components are conditioned to 77°F and mixed in accordance with the manufacturer's instructions. The pot life of the material shall be considered to have ended when the viscosity reaches 850 poisesXs (Brookfield Model MBT with Helipath Attachment) at 77°F ambient. The time from initial mixing of the components until the mixture reaches 850 poisesXs shall be recorded as the pot life.

**Initial Viscosity.** The initial viscosity shall be measured with a Brookfield Model HBT, Spindle No. 3 at 20 rpm.

**Tack Free Time.** The epoxy mixture shall remain tacky and capable of bonding during a contact period of at least two hours at 77°F ambient measured from the time of spreading.

**Degree of Temporary Gelation.** The epoxy grout mixture shall have a degree of temporary gelation such that a 1/8 inch film can be maintained on the surface of a standard 2 x 5 inch paint panel after dripping ceases.

**Compressive Shear Test.** The test shall be performed in accordance with Federal Specification MMM-B-350 Paragraph 4.4.3 except that hand mixing of the epoxy will be permitted.

**Beam Break Test.** The specimens shall be tested for flexural strength using a simple beam with third point loading. The specimen shall be prepared and tested in accordance with ASTM Methods C192 and C78 except that the concrete shall be designed for 800 - 900 psi flexural strength and shall be cast in 3 x 4 x 16 inch molds using a well-graded coarse aggregate all of which passes a 1 inch square sieve. Each beam to be tested shall be sawed transversely at midpoint, the sawed faces etched with a 10 percent aqueous solution of HCl and then thoroughly washed, and bonded with a 10 mil thickness of the epoxy adhesive under test. The surface to be bonded shall be maintained in a vertical position during application and cure of epoxy adhesive and plastic concrete. The hardened specimens shall be cured for a total time of at least 96 hours. During the last 24 hours of the curing period, they shall be immersed in water.

The result reported shall be the average of two tests. Any result below 400 psi which fails outside the plane of adhesion will be disregarded and a retest performed. Any result below 800 psi and above 400 psi, of which 80% of the failure occurs outside the plane of adhesion, shall be considered acceptable. Any result above 800 psi will be considered acceptable regardless of where the failure occurs.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at manufacture or supply locations in accordance with procedural directives of the Materials Bureau. The expiration date of acceptance of this material shall be one year after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

## **721-04 (VACANT)**

## **721-05 EPOXY REPAIR PASTE**

**SCOPE.** This specification covers the material requirements of a two-component, flexible, rapid-hardening epoxy resin paste for making epoxy mortar. This material is used for the repair and sealing of cracks and other minor damaged areas in hardened concrete. It is suitable for patching on horizontal, vertical, and overhead applications. It develops high early strengths and achieves final cure in seven (7) days. This material shall not be used when the concrete or ambient temperature is below 50°F or above 100°F. It is suitable for damp, moist, and underwater applications.

## **MATERIAL REQUIREMENTS**

**Component A.** Component A shall be the condensation product of the reaction of bisphenol A with epichlorohydrin. It may contain fillers but shall not contain non-reactive diluents. When mixed with Component B the mixture shall have the characteristics described under Characteristics of the Mixture.

**Component B.** Component B shall be the curing agent for the system and shall be capable of curing the system from 40°F and above when mixed according to the manufacturer's instructions. It shall contain no non-reactive diluents but may contain flexibilizers or fillers. Component B shall be completely reactive with Component A.

Components A and B shall each have a shelf life of one (1) year.

**Characteristics of the Mixture.** When Components A and B are mixed according to the manufacturer's instructions, the mixture will have a paste or gel consistency such that a 1/2 inch thick layer of the mixture will not sag or drip from an overhead surface throughout the temperature range from 50°F to 100°F. It shall also have the following characteristics:

Property	Requirement
Pot Life @ 77°F, minutes	10 min.- 60 max.

**Properties of Cured Material.** For testing purposes the Components A and B shall be mixed with ASTM C109 Ottawa Silica Sand in the ratio of 1 part sand to 1 part epoxy by volume. This paste shall also be non-sagging and non-dripping as stated under Characteristics of the Mixture. The cured material shall have the following physical properties:

TABLE 721-05-1 CURED MATERIAL REQUIREMENTS		
Property	Test Method	Minimum
Compressive Strength <sup>1</sup> , psi	AASHTO T 106	3,000
Bond Test Modulus of Rupture, psi	See Testing	800
Freeze-Thaw	See Testing	80% Bond Strength

**NOTE:** 2 inch cubic samples conditioned 24 hrs.

**PACKAGING.** All materials furnished shall be shipped in strong, substantial containers. The containers shall be identified as “Part A contains epoxy resin” and “Part B contains curing agent.” It shall also be plainly marked with the following information:

- N.Y.S.D.O.T. materials specification number
- Name of product
- Mixing proportions and instructions
- Name and address of manufacturer
- Lot number and batch number
- Date of manufacturer
- Quantity
- Date of expiration of acceptance.

**TESTING**

**Pot Life.** The components will be conditioned to 77°F and mixed according to the manufacturer's instructions. A 60±0.4 g. total weight will be placed in an unwaxed paper cup and placed on a work bench. The mixture will be probed every 2 minutes with a small stick starting 8 minutes from the time of mixing. The time at which a small ball forms in the center of the container is recorded as the pot life.

**Bond Test.** The epoxy will be tested for flexural strength using a simple beam with third point loading. The concrete will be designed for 800 to 900 psi flexural strength and will be cast in 3 x 4 x 16 inch molds using a well-graded coarse aggregate all of which passes a 1 inch square sieve. Each beam to be tested will be sawed transversely at midpoint, the sawed faces etched with a 10% aqueous solution of HCL and then thoroughly washed. A 10 mil thickness of the epoxy adhesive under test will be applied to both wet etched surfaces while in a vertical position and worked into the surface. One of the prism halves will be inverted and placed on the matching half and allowed to cure for 72 hours.

The result reported will be the average of two tests. Any result below 400 psi which fails outside the plane of adhesion will be disregarded and a retest performed. Any result below 800 psi and above 400 psi, of which 80% of the failure occurs outside the plane of adhesion, will be considered acceptable. Any result above 800 psi will be considered acceptable regardless of where the failure occurs.

**Freeze-Thaw.** Testing will be conducted in accordance with New York Test Method 216. In addition bond test specimens will be subjected to 7 freeze-thaw cycles before breaking in third point loading. A bond strength of 80% of the original average bond strength will be considered acceptable.

**BASIS OF ACCEPTANCE.** This material will be considered for acceptance in stock lot quantities at the manufacture or supply locations in accordance with procedural directives of the Materials Bureau.

The expiration date of acceptance of this material shall be one year after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the job site will be cause for rejection of the material.

**721-06 THRU 721-19 (VACANT)**

**721-20 RAPID HARDENING POLYMER CONCRETE**

**SCOPE.** This specification covers the material requirements of a two component, rapid hardening, methyl methacrylate based polymer concrete repair material. The material is used with a primer to repair hardened concrete.

**MATERIALS REQUIREMENTS**

**Polymer Concrete Mortar.** The polymer concrete mortar shall be a two component methyl methacrylate based system. One component shall be a premixed powder consisting of catalyst, fine fillers, and fine aggregate not to exceed 1/16 inch in size. The other component shall be a methyl methacrylate monomer liquid capable of chemically reacting with the powder component such that the mixture hardens to a completely cured condition within three (3) hours at temperatures between 35°F and 100°F inclusive. The working life of the mixture shall be a minimum of 10 minutes and its workability shall be consistent throughout the above temperature range. The shelf life of the unopened components, stored at room temperature and in a dry atmosphere, shall be 6 months, minimum. Material older than 12 months from the date of manufacturer shall not be used.

**Properties of Cured Polymer Concrete.** Polymer Concrete Mortar specimens, when prepared in accordance with the manufacturer's mixing instructions, shall exhibit the following properties when cured 168±2 hours at 73°F± 5°F:

<b>TABLE 721-20-1 CURED POLYMER CONCRETE REQUIREMENTS</b>				
<b>Property</b>		<b>Test Method</b>	<b>Min.</b>	<b>Max.</b>
Modulus of Rupture,	psi	ASTM C580	1,500	---
Elastic Modulus,	psi	ASTM C580	0.5x10 <sup>6</sup>	1.0x10 <sup>6</sup>
Thermal Expansion Coefficient,	in/in/°F	ASTM C531	(1.0 to 2.0) x 10 <sup>-5</sup>	---



The material shall also exhibit the following properties when tested under NYSDOT Test Method 701-13F:

A minimum one hour compressive strength of 2500 psi, a 24 hour strength of 3500 psi, and a 28 day strength of 5000 psi.

Be able to withstand 50 cycles of freeze-thaw (10% NaCl solution) with a maximum loss of 4%.

**Primer.** The primer shall be a two component methyl methacrylate resin system capable of enhancing the bond between the polymer concrete and the substrate. It shall have a curing time of 20 to 60 minutes at temperatures between 35°F and 100°F inclusive.

**Flammability.** The polymer concrete shall not support or sustain combustion within five (5) minutes after mixing.

**PACKAGING.** The material delivered from the manufacturer shall be in moisture proof bags and the contents shall weigh within  $\pm 3\%$  of the labeled bag weight. The manufacturer's name, address, date of manufacture and mixing instructions shall be printed on each bag.

**BASIS OF ACCEPTANCE.** Application for material approval shall be submitted to the Director of the Materials Bureau accompanied by at least a 50 lbs, production run, sample of material. Upon approval, the name of the product will be placed on the Department's Approved List. Products so listed will be acceptable at the work site on the basis of the brand name labeled on the container. The Department reserves the right to sample and test the material at any time.

## 721-99 FOR SITE MANAGER USE

### SECTION 722 - WATER SUPPLY

#### 722-01 DUCTILE IRON WATER PIPE, FITTINGS AND ENCASUREMENT

**SCOPE.** This specification covers the material and quality requirements for ductile iron water pipe, miscellaneous fittings, coatings and encasement.

**GENERAL.** Ductile iron water pipe, fittings and encasement shall conform to the requirements of the following:

Cement-Mortar Lining for

Ductile-Iron Pipe and Fittings for Water

AWWA C104 / ANSI A21.4

Polyethylene Encasement for Ductile-Iron Pipe Systems

AWWA C105 / ANSI A21.5

Ductile Iron and Gray Iron Fittings, 3 through 48 in. diam.

for Water

AWWA C110 / ANSI A21.10

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe  
and Fittings

AWWA C111 / ANSI A21.11

Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron  
Threaded Flanges

AWWA C115 / ANSI A21.15

Protective Fusion-Bonded Epoxy Coating for the Interior and  
Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings  
for Water Supply Service

AWWA C116 / ANSI A21.16

Thickness Design of Ductile-Iron Pipe

AWWA C150 / ANSI A21.50

Ductile-Iron Pipe, Centrifugally Cast, for Water

AWWA C151 / ANSI A21.51

Ductile-Iron Compact Fittings, 3 through 24 in. diam.  
and 54 through 64 in. diam., for Water Service

AWWA C153 / ANSI A21.53

**BASIS OF ACCEPTANCE.** Ductile iron water pipe and fittings will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification for iron fittings shall list a fitting description, quantity, bare fitting weight and source, (AWWA Standard C110, C153 or Manufacturer, if fitting is not listed in either standard). The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## **722-02 STEEL WATER PIPE AND FITTINGS**

**SCOPE.** This specification covers the material and quality requirements for steel water pipe and miscellaneous fittings.

**GENERAL.** Steel water pipe and fittings shall conform to the requirements of the following:

Steel Water Pipe - 6 in. diam. and Larger	AWWA C200
Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied	AWWA C203
Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. diam. and Larger - Shop Applied	AWWA C205
Field Welding of Steel Water Pipe	AWWA C206
Steel Pipe Flanges for Waterworks Service - Sizes 4 to 144 in. diam.	AWWA C207
Dimensions for Fabricated Steel Water Pipe Fittings	AWWA C208
Cold-Applied Exterior Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines	AWWA C209
Liquid-Epoxy Coatings for Steel Pipelines	AWWA C210
Fusion-Bonded Epoxy Coatings Systems for the Interior and Exterior of Steel Water Pipelines	AWWA C213
Tape Coating Systems for the Exterior of Steel Water Pipelines	AWWA C214
Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines	AWWA C215
Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Fittings for Buried or Submerged Steel Water Pipelines	AWWA C216
Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Buried Steel Water Pipelines	AWWA C217
Coating the Exterior of Aboveground Steel Water Pipelines and Fittings	AWWA C218
Bolted, Sleeve-Type Couplings for Plain-End Pipe	AWWA C219
Stainless-Steel Pipe, 4 in. diam. and Larger	AWWA C220
Fabricated Steel Mechanical Slip-Type Expansion Joints	AWWA C221
Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe Fittings	AWWA C222

**BASIS OF ACCEPTANCE.** Steel water pipe and fittings will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## **722-03 CONCRETE WATER PIPE**

**SCOPE.** This specification covers the material and quality requirements for concrete water pipe.

**GENERAL.** Concrete water pipe shall conform to the requirements of the following:

Reinforced Concrete Pressure Pipe, Steel Cylinder Type	AWWA C300
Prestressed Concrete Pressure Pipe, Steel Cylinder Type	AWWA C301
Reinforced Concrete Pressure Pipe, Noncylinder Type	AWWA C302
Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type	AWWA C303

**BASIS OF ACCEPTANCE.** Concrete water pipe will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

#### **722-04 WATER VALVES AND HYDRANTS**

**SCOPE.** This specification covers the material and quality requirements for water valves and hydrants.

**GENERAL.** Water valves and hydrants shall conform to the requirements of the following:

Metal-Seated Gate Valves for Water Supply Service	AWWA C500
Cast-Iron Sluice Gates	AWWA C501
Dry Barrel Hydrants	AWWA C502
Rubber-Seated Butterfly Valves	AWWA C504
Ball Valves (6 through 48 in. diam.)	AWWA C507
Swing Check Valves for Waterworks Service (2 through 24 in. diam.)	AWWA C508
Resilient-Seated Gate Valves	AWWA C509
Double-Check Valve Backflow Prevention Assembly	AWWA C510
Reduced-Pressure Principle Backflow Prevention Assembly	AWWA C511
Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Service	AWWA C512
Open-Channel, Fabricated Metal Slides	AWWA C513
Reduced-Wall, Resilient Seated Gate Valves for Water Supply Service	AWWA C515
Power Actuating Devices for Valves and Sluice Gates	AWWA C540
Protective Epoxy Interior Coatings for Valves and Hydrants	AWWA C550

**BASIS OF ACCEPTANCE.** Water valves and hydrants will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

#### **722-05 PLASTIC WATER PIPE AND FITTINGS**

**SCOPE.** This specification covers the material and quality requirements for plastic water pipe and fittings.

**GENERAL.** Plastic water pipe and fittings shall conform to the requirements of the following:

Polyvinyl Chloride (PVC) Pressure Pipe 4 through 12 in. diam.

for Water Distribution	AWWA C900
Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings (14 through 48 in. diam.) for Water Transmission and Distribution	AWWA C905
Polyethylene Water Pipe and Fittings, 4 through 63 in. diam., for Water Distribution and Transmission	AWWA C906
Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4 through 8 in. diam.	AWWA C907
PVC Self-Tapping Saddle Tees for Use on PVC Pipe	AWWA C908
Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 through 12 in. diam.	AWWA C909
Fiberglass Pressure Pipe	AWWA C950

**BASIS OF ACCEPTANCE.** Plastic water pipe and fittings will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## 722-06 WATER SERVICE PIPE, SERVICE VALVES AND FITTINGS

**SCOPE.** This specification covers the material and quality requirements for water service pipe, service valves and fittings.

**GENERAL.** Water service pipe, service valves and fittings shall conform to the requirements of the following:

Underground Service Line Valves and Fittings	AWWA C800
Polyethylene (PE) Pressure Pipe and Tubing (1/2 through 3 in. diam.) for Water Service	AWWA C901
Steel Water Service Pipe (1/2 to 4 in. diam.)	ASTM A53
Seamless Copper Water Tube, Type K	ASTM B88

**BASIS OF ACCEPTANCE.** Water service pipe, service valves and fittings will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## 722-07 WEDGE TYPE MECHANICAL RESTRAINT GLANDS

**SCOPE.** This specification covers the material and quality requirements for wedge type mechanical restraint glands.

**GENERAL.** Wedge type mechanical restraint glands shall have a number of individually activated wedges around the circumference of a pipe which grip the pipe surface and bolts through the gland which are attached to a fitting or a gland that restrains a pipe bell. Glands shall be constructed of high strength ductile iron in accordance with ASTM Standard A536, and shall have a minimum pressure rating exceeding the system test pressure identified in the Owner requirements. Glands shall be specifically manufactured for the type of pipe used, and may be solid or split ring (two piece). Glands shall be manufactured with twist off bolts.

**BASIS OF ACCEPTANCE.** Wedge type mechanical restraint glands will be accepted on the basis of the Manufacturer=s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## **722-08 INSULATION FOR WATER MAINS**

**SCOPE.** This specification covers the material and quality requirements for insulation for water mains.

**GENERAL.** Insulation for water mains shall be made of fiberglass, cellular glass, urethane or cellular phenol and shall conform to the requirements of the following:

Fiberglass Pipe Insulation	ASTM C547
Cellular Glass Insulation	ASTM C552
Urethane Foam Pipe Insulation	ASTM C591
Spray Applied Urethane Insulation	ASTM C1029
Rigid Cellular Phenolic Pipe Insulation	ASTM C1126, Type III
Waterproof Jacket for Insulation	ASTM C1136

**BASIS OF ACCEPTANCE.** Insulation for water mains will be accepted on the basis of the Manufacturer’s certification that the material conforms to this specification. The certification shall accompany the material delivered to the project site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

## **722-99 FOR SITE MANAGER USE**

### **SECTION 723 - LIGHTING**

#### **723-01 ALUMINUM LIGHT STANDARDS AND ARMS**

**SCOPE.** This specification covers the material and quality requirements for aluminum light standard shafts and aluminum bracket arms.

#### **MATERIAL REQUIREMENTS**

**General.** All light standards and arms shall be designed in accordance with the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. The ARTBA Guide to Standardized Highway Lighting Pole Hardware may be used in conjunction with the AASHTO Standard Specifications in lieu of actual design computations. Wind pressure for design purposes shall be determined in accordance with the above AASHTO Standard Specifications, utilizing the wind speeds listed below. In addition, the dimensions of all lighting hardware shall also be consistent with the requirements of the appropriate maintenance agency.

**Shaft.** The shaft shall be a one-piece, seamless, round tapered spun aluminum tube of alloy 6063. The aluminum shaft shall be heat treated for its full length to produce a T6 temper, and an anchor base shall be welded to the bottom of the shaft. Shafts, which are to be mounted without transformer bases, shall be equipped with a 4 inch wide by 6 inch to 8 inch high reinforced handhole centered 14 to 18 inches above the base of the shaft, and located 90 degrees from the plane of the arm and on the side away from traffic if possible. Each handhole shall have a cover with stainless steel attachment screws to secure the cover.

A grounding nut shall be provided inside the shaft opposite the handhole to accommodate a 1/2 inch threaded bolt or stud. The shaft shall have a satin finish accomplished by mechanical rotary grinding.

An anchor base shall be joined to the shaft by means of complete circumferential welds, externally at top of anchor base and internally at bottom of shaft.

The anchor base shall be a one-piece permanent mold casting, aluminum alloy 356-T6 provided with four (4) slots to receive 1 inch diameter bolts. The casting shall be free of cracks, pits, blow holes and non-metallic inclusions. Each anchor base shall be provided with four anchor bolt covers fabricated from aluminum alloy with stainless steel screws for attaching the covers.

If bracket arm light standards are proposed, a removable ornamental cast aluminum pole cap with stainless steel setscrews to hold it in place shall be provided and installed on the top of each shaft. A 1 1/2 inch diameter hole shall be furnished near the top of each shaft where the arm is to be attached to provide a cable entrance from the shaft into the bracket arm. The opening shall have an approved metal or rubber grommet placed to provide a smooth cable guide for pulling the electrical cable through. The pole cap and hole are not required for davit arm light standards. Wall thickness and tube diameters for 80 mph wind zones shall conform to Table 723-01-1 Light Standard Dimensions.

**Truss Arms.** The upper and lower members shall be fabricated from seamless tubing of 6063-T6 or 6061-T6 aluminum alloy. The upper member shall be the continuous or wiring member and shall have a 1/8 inch minimum wall thickness. Truss bracket arms shall be designed with the upper and lower members joined near the luminaire end of the arm. The arms shall be braced with one or two vertical pipe struts depending on the arm length. Each truss bracket arm shall be equipped with a 2 inch pipe size slip fitter tenon projecting 5 inches from the luminaire end. The arm shall be secured to the shaft with a bolt type or clamp type attachment similar to those shown in drawings ASA 2-1 or ASA 2-2 of the ARTBA Guide to Standardized Highway Lighting Pole Hardware. Attachments that require welding a fitting directly onto the shaft, similar to ARTBA drawing SPS 2-1, will not be allowed on aluminum light pole shafts. Bolts and nuts shall be fabricated from AISI Type 302 stainless steel according to ANSI B1.1. Washers shall be fabricated from AISI 300 series stainless steel according to the requirements of ANSI B18.21.2. In projects where arm lengths are intermixed, the rise for each length is to be set to keep the upper chord of all arms at approximately equal slopes.

<b>TABLE 723-01-1 LIGHT STANDARD DIMENSIONS</b>			
<b>Maximum Pole Height (ft-in)</b>	<b>Maximum Arm Lengths (ft)</b>	<b>Minimum Wall Thickness (in)</b>	<b>Minimum Diameter Bottom x Top (in)</b>
26	15	3/16	8 x 6
29-6	15	3/16	8 x 6
29-6	20	1/4	9 x 6
36	15	3/16	8 x 6
36	20	1/4	10 x 6
42-6	15	3/16	10 x 6
42-6	20	1/4	10 x 6
46	15	1/4	10 x 6
52-6	15	1/4	10 x 6
26	15*	3/16	8 x 6
29-6	15*	1/4	8 x 6
36	15*	1/4	10 x 6
42-6	15*	1/4	10 x 6
46	15*	5/16	10 x 6

52-6	15*	1/4	12 x 6
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**NOTE:** \*Twin-Arm.

**Single Bracket Arms.** 4 to 8 feet. The single member arms shall be fabricated from seamless tubing of 6063-T6 or 6061-T6 aluminum alloy. Wall thickness shall not be less than 1/8 inch. The arms shall be designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Each arm shall be equipped with a 2 in. diam. pipe size slip fitter tenon projecting 6 - 8 inches from the luminaire end. The arms shall be secured to the shaft with a bolt type or clamp type attachment similar to those shown in drawings ASA 2-1 or ASA 2-2 of the ARTBA Guide to Standardized Highway Lighting Pole Hardware. Attachments that require welding a fitting directly onto the shaft, similar to ARTBA drawing SPS 2-1, will not be allowed on aluminum light pole shafts. Bolts and nuts shall be fabricated from AISI Type 302 stainless steel according to ANSI B1.1 Washers shall be fabricated from AISI 300 series stainless steel according to the requirements of ANSI B18.21.2.

**Bracket Arms for Wood Utility Poles.** Bracket arms to be mounted on wooden utility poles shall be tapered, seamless tube aluminum with a 1/8 inch minimum wall thickness. The bracket arm shall be welded to an appropriate connection plate at the pole end and have a 2 inch slip-fitter tenon at the luminaire end. A 1 1/4 inch cable opening on the underside near the pole shall be protected with a rubber grommet. Arms over 6 feet long shall be trussed, with upper and lower members securely joined by means of vertical strut(s). All aluminum shall be alloy 6063-T6 and all connecting hardware such as nuts, bolts, etc. shall be stainless steel.

**Davit Arm Poles.** For davit arm poles the top of the shaft shall terminate in a tenon (or twin tenons for double arm poles) and be equipped with a friction fit outer sleeve to produce a flush joint with the arms(s). The davit arms(s) shall be constructed of the materials and methods specified for the shaft and as dimensioned on the drawings. The davit arm(s) shall be secured to the shaft in a flush connection with two stainless steel bolts, nuts and lockwashers. The davit arms(s) shall terminate in a cast or fabricated flush tenon for a slipfit connection to the luminaire. The tenon shall be secured to the davit arm by stainless steel bolts.

**SHIPPING.** Shafts and arms shall be tire-wrapped with a heavy water resistant paper, for protection during shipping and installation. All small parts shall be boxed.

**Wind speeds.** Poles, arms and attachments covered by this specification shall be designed for the following wind speeds in accordance with the AASHTO Standard mentioned above.

- 80 mph - Counties of Allegany, Bronx, Cattaraugus, Chautauqua, Erie, Genesee, Kings, Livingston, Monroe, Nassau, New York, Niagara, Orleans, Ontario, Queens, Richmond, Rockland, Suffolk, Wayne, Westchester & Wyoming.
- 70 mph - All Other Counties.

**Welding.** All aluminum welding on light standards shall be performed in the shop, using the inert metal-arc welding process. Filler metal shall conform to the A.W.S. Specification A5-10. Welders shall be certified by A.S.M.E. Section 9 or A.W.S. D 1.2.

**Vibration Shims.** Vibration shims (dampeners) shall be provided by the pole manufacturer for all aluminum poles 30 feet or longer. Vibration shims shall also be provided for poles installed in excessively windy locations or on viaducts with continuous vibration.

**BASIS OF ACCEPTANCE.** Acceptance of the shaft, anchor base, truss bracket arms, and single member arms covered by this specification will be based on:

- Manufacturer's certification of compliance with these specification requirements.
- Submission, to the Engineer, of design and fabrication details for each shaft, anchor base and arm intended for a particular design load as specified in the contract documents. The design and fabrication details being submitted shall have been approved and signed by a professional engineer licensed to practice in New York State. This submission shall be sent in time to be received at least 10 working days prior to the date the Contractor orders the poles, anchor bases and arms.

## **723-02 HIGH MAST POLE, HEAD FRAME ASSEMBLY WITH LUMINAIRE RING AND LOWERING DEVICE**

**SCOPE.** This specification covers the material and quality requirements for the pole and head frame assembly with luminaire ring and lowering device to be used in a high mast lighting system.

### **MATERIAL REQUIREMENTS**

**General.** The steel pole, head frame assembly, luminaire ring and lowering system shall be designed to meet or exceed the *AASHTO Standard Specifications, for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2009* with interims, with a Fatigue Importance Category of I. The design wind loading shall be chosen to be consistent with the location of the structure and the height factor. See §723-01 *Aluminum Light Standards and Arms*. The Contractor shall obtain verification of all necessary weights and effective projected areas as required in the contract documents.

**Poles.** The pole shall meet the requirements of one of the following specifications:

ASTM A53,	Welded and Seamless Steel Pipe, Grade B, Type E or S
ASTM A500,	Welded and Seamless Steel Pipe, Grade B (Rounds Only)
ASTM 252,	Welded and Seamless Pipe, Grade 2 or 3, provided that the chemical certifications meet the requirements for ASTM A53, Grade B Type E or S.

The high mast steel pole shall be capable of supporting the combined weight and projected area of both the lowering system and number of luminaires with built-in ballast as shown on the contract documents.

The high mast pole shall consist of sections of tapered steel tubes, a round cross section, which telescopes into each other with an overlap of 1.5 diameters. Steel used in fabricating the shaft shall have a minimum yield strength of 50,000 psi after all fabricating operations have been completed.

The base of the pole shall have an adequate size hand hole complete with a weatherproof cover and lock. A plate shall be welded opposite the hand hole for mounting the lowering system winch (unless externally mounted on the portable power drive), circuit breakers and other hardware. The hand hole area shall have a 6 feet reinforcing sleeve. The hand hole and plate shall be designed to accommodate the required High Mast Head Frame and Lowering Assembly.

The high mast pole shall be galvanized after fabrication in accordance with §719-01 Coating and Repair Methods, Type 1.

**Anchor Base.** The anchor base shall be fabricated of steel meeting or exceeding the yield strength of ASTM A-36M. The anchor base shall telescope the butt end of the pole and be welded on the inside bottom and outside top.



**Anchor bolts, nuts, and washers.** Anchor bolts and nuts shall be ASTM F1554 Grade 36 or 55. The top of the anchor bolts shall have a minimum 9 inches of thread. Nuts, washers and a minimum of 12 inches of the top of anchor bolts shall be hot-dipped galvanized in accordance with the requirements of 719-01 *Galvanized Coating and Repair Method, Type II*. Each bolt shall be furnished with two (2) heavy duty, galvanized, hex nuts with a strength equal to or exceeding the proof load of the bolts. Washers shall be plain hardened washers. The Contractor may wish to install pre-assembled anchor bolt cages, subject to approval by the Engineer, in lieu of the design shown in the contract documents.

The pole manufacturer shall design the anchor bolts and nuts in accordance with AASHTO *Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, 2009 with interims, with a Fatigue Importance Category of I.

**Welding.** Pole sections shall have no more than two longitudinal welded seam and no transverse seams. All welding shall be performed in accordance with the N.Y.S. Steel Construction Manual. Longitudinal welds shall have a minimum 60% penetration. All circumferential welds for slip joints and shaft to base shall be 100% penetration. All 100% welds shall be inspected ultrasonically by the State.

**Reinforcing sleeve.** The reinforcing sleeve shall be fabricated of steel meeting or exceeding AISI 1020 steel. The sleeve shall be galvanized under the same ASTM specification as the pole.

**Head Frame.** The head frame shall be capable of supporting the combined weight and projected areas of the luminaire ring assembly and luminaires with built in ballast as shown on the plans. The luminaire ring shall be designed to use the number and configuration of luminaires shown on the plans.

The head frame shall be equipped with a suitable weather resistant and bird proof cover.

The head frame shall be a zinc-coated steel structure attached to the pole by means of a steel slip fitter and secured by at least four (4) stainless steel set screws.

The head frame shall provide at least three point suspension for the luminaire ring assembly.

For raising and lowering the luminaire ring assembly, three 7x19 aircraft-grade stainless steel, hoisting cables, of sufficient size to support the load shall be included. Hoisting cable sheaves shall be grooved to the exact diameter of the hoisting cable for 180° bearing surface and be equipped with suitable guides to prevent jumping the sheaves. Sheave bearings shall be permanently lubricated on stainless steel shafts.

Permanently lubricated power cable sheave(s) shall be provided over a stainless steel shaft. The grooved diameter of the sheave(s) shall be coordinated with the power cable diameter and be equipped with guides to prevent jumping the sheave(s).

The power cable supplied shall be a minimum of 20 feet longer than the street lighting pole installed. It shall be a water proof cable with the necessary number of conductors and sized to properly operate the street lighting system.

Three latching devices shall be provided to support the luminaire ring assembly when in the latched position. There will be no tension on the hoisting cables when the luminaire ring is in the latched position. The latches shall be actuated from the ground. Locking of the luminaire ring shall be signalled by indicators visible from the ground. All moving parts of the latch mechanism shall be serviceable from the ground. The latching mechanism shall not be impaired by the formation of ice and shall not require adjustment. Each of the latches, independently, shall be strong enough to support eight times the weight of the luminaire ring assembly and all luminaires installed.

**Lowering System and Luminaire Assembly.** The luminaire ring assembly shall be fabricated of steel with the appropriate number of 2 inch nominal steel pipe mounting arms. It shall be zinc plated and prewired to distribute the power to the required number of luminaires. Power cables shall be positively attached to the ring assembly through a watertight wiring chamber, with watertight cable connectors. A 600 volt terminal block, completely prewired shall be included in the watertight wiring chamber. A watertight twist lock power receptacle shall be installed in the luminaire ring to allow testing of the

luminaires at ground level. A cable support shall be provided to hold the power cable in the luminaire ring.

Attached to the luminaire ring assembly shall be a spring loaded roller contact guidance mechanism with a minimum of three arms that maintain positive contact with the pole surface, centering and guiding the ring assembly during lowering to prevent jamming. Rollers shall be made of water resistant non-marking material with permanently lubricated bearings on stainless steel shafts.

Winch Assembly, if permanently mounted in the pole, shall be a worm-gear self locking type (Torque rated) and designed for both hand operation or operation by means of a portable power unit. Winch Cable shall be 1/4 inch or greater diameter, stainless steel aircraft cable to support the load. There shall be a take-up guide on the winch assembly to eliminate cable 'fall-off'. Compression springs shall be used in the connection of the hoisting cables to the luminaire ring assembly, but ultimate support of the luminaire ring will not be sacrificed by individual or total compression spring failure.

The lowering system shall also include circuit breaker assembly, twist-lock receptacle and plugs for the power cable.

**BASIS OF APPROVAL.** If the Contractor proposes to use a shape of pole and/or appurtenances different from that indicated in the contract documents, written approval of the change in shape must be received from the Engineer prior to fabrication of the poles and/or appurtenances. The differences shall be highlighted on the shop drawings submitted to the Office of Structures for approval. Where the pole and/or appurtenances to be used are not as indicated in the contract documents, the manufacturer shall certify, in writing that the pole and/or appurtenances supplied meet or exceed the capacity of the pole and/or appurtenances indicated in the contract documents.

**BASIS OF ACCEPTANCE.** Acceptance of the steel poles and appurtenances will be based on the delivery, by the Contractor to the Engineer, of a manufacturer's certification, signed by a Professional Engineer, of compliance with the specification requirements and the details of the poles and their appurtenances as indicated in the contract documents. The Contractor shall submit to the Engineer five copies of the shop drawings, approved by DCES, that were used to fabricate the poles and appurtenances.

### **723-03 PORTABLE POWER DRIVE FOR HIGH MAST LUMINAIRE LOWERING SYSTEM**

**SCOPE.** This specification covers the functional requirements for a portable power drive unit, and winch when necessary, issued for a High Mast Luminaire Lowering System.

**MATERIAL REQUIREMENTS.** The portable power drive unit shall be a heavy duty reversing electric drill motor and drive shaft coupled with a torque limiter which shall supply all of the necessary driving power to the winch. A portable winch assembly shall be included with the portable power drive unit unless the winch has been permanently installed in the base of the high mast pole. The power drive shall be provided with a step down transformer and a remote control cord which will enable the operator to stand at least 16 feet 6 inches from the pole. The unit shall be designed so as to be simply strapped to the base of the pole with a quick-connect securing mechanism that will accommodate any size or shape pole. The unit shall be capable of raising or lowering the lowering ring and luminaires at an approximate rate of 10 feet per minute. All aspects of the power drive shall be compatible with the detailing of the pole base and the lowering system for which it is to be used.

Detail specifications, parts lists, instruction sheets and shop drawings of the portable power drive shall be submitted in accordance with 670-3.02 Shop Drawings.

**BASIS OF ACCEPTANCE:** Acceptance of the portable power drive will be based on the manufacturer's certificate of compliance with these specification requirements, and the Engineer's approval of the detail specifications and shop drawings.

## **723-04 THRU 723-09 (VACANT)**

### **723-10 ANCHOR BASE (ALUMINUM)**

**SCOPE.** This specification covers the material and quality requirements for cast aluminum anchor bases for lighting standards.

**MATERIAL REQUIREMENTS.** Aluminum anchor bases shall be a one piece casting of 356.0 aluminum alloy. The casting shall be free of cracks, pits, blow holes and non-metallic inclusions. Each anchor base shall be provided with four anchor bolt covers fabricated from B443.0 aluminum alloy with stainless steel screws for attaching the covers.

**BASIS OF ACCEPTANCE.** Anchor bases will be accepted upon the manufacturer's certification that they meet the requirements of this section.

## **723-11 THRU 723-14 (VACANT)**

### **723-15 BREAKAWAY TRANSFORMER BASE (ALUMINUM)**

**SCOPE.** This specification covers the material and quality requirements for Breakaway Aluminum Transformer Bases for Lighting Standards.

**GENERAL.** Transformer bases shall be one-piece aluminum alloy sand or aluminum alloy permanent-mold castings. The bases shall be equipped with a removable, aluminum or plastic, trapezoidal shaped door (approximately 12 inches high; 7 inches wide (top); 9 inches wide (bottom). Each door shall be secured to the base with a stainless steel screw(s).

For attachment to the shaft anchor base, each transformer base shall be supplied with four (4) loose bearing plates or other acceptable bearing surfaces and four (4) 1 inch diameter by 3 3/4 inch long or longer hot-dipped galvanized hexhead machine bolts.

A grounding connection, accommodating a 1/2 inch threaded bolt or nut shall be provided inside each transformer base.

The light pole manufacturer shall obtain the base and bolt circle dimensions from the plans and shall then provide the Contractor with a template print, giving complete information for setting the anchor bolts.

Transformer bases shall be so designed as to minimize the possibility of hooking or snagging an impacting vehicle.

**MATERIAL REQUIREMENTS.** Transformer bases shall be cast of Aluminum-Alloy 356.0-T6 (SG70A-T6) in conformance with ASTM B26M, Aluminum-Alloy Sand Castings or ASTM B108, Aluminum-Alloy Permanent Mold Castings. The trapezoidal shaped door shall be fabricated from B443.0 (S5A) or 356.0-T6 (SG70A-T6) Aluminum Alloy.

Transformer bases and doors may be made of an Aluminum Alloy equivalent to 356.0-T6 (SG70A-T6) upon approval of the Materials Bureau.

**TESTS.** To determine acceptable breakaway characteristics, transformer bases shall be subjected to dynamic laboratory testing. The test shall apply to transformer bases accommodating poles of less than 700 pounds in weight (including luminaire and bracket) and poles of less than 50 foot mounting height only.

A full size pole, together with luminaire or a suitable weight to simulate the luminaire, shall be mounted on the transformer base. A ballistic pendulum, equipped with a crushable nose, as approved by FHWA, and weighing 1800 pounds, shall be swung in such a manner so as to strike the transformer base

at a velocity of 20 mph. The point of impact shall be at a height of 20 inches from the bottom of the transformer base.

Transformer bases shall be considered to have acceptable breakaway features if they produce a change in velocity of 18 feet per second or less. For further specific information concerning the test equipment and procedure, contact the Materials Bureau.

**BASIS OF ACCEPTANCE.** The Department requires the submission of Materials Details. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the product and/or supplier, and the reference number assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted on the basis of their brand name and conformance to the approved Materials Details.

The supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 10 days prior to the use of the product.

### **723-16 THRU 723-18 (VACANT)**

### **723-19 RIGID PLASTIC CONDUIT**

**SCOPE.** This specification covers the material requirements for rigid plastic conduits (PVC and high-density PE) for use as raceway for wires or cables of an electrical system. Rigid plastic conduit is acceptable for up to 167°F wiring service. Rigid PVC (polyvinyl chloride) conduit is suitable for installation above or below ground and with or without concrete encasement; high-density PE (polyethylene) conduit is intended for below ground installations only, and with or without concrete encasement.

**GENERAL.** Under these requirements either Class 1, Heavy Wall PVC or Class 2, High Density PE conduit may be supplied for underground installation. For above ground use, only Class 1 conduit shall be allowed.

**MATERIAL REQUIREMENTS.** Rigid plastic conduit shall conform to the requirements of UL 651A. All fittings, couplings and expansion fittings shall conform to the applicable requirements of UL514A. Solvent cement for joining Class 1 conduit and conduit fittings shall meet the requirements of ASTM D2564, or alternately be of the type recommended by the conduit manufacturer. Unless otherwise recommended by the manufacturer, fittings for Class 2 conduit shall be of a drive-on type and solvent cement will not be needed for “jointing.”

**BASIS OF ACCEPTANCE.** Rigid plastic conduit shall be accepted upon the basis of the manufacturer's certification that it meets the requirements of this specification, as well as being Underwriters Laboratory Listed. Fittings, couplings and solvent cement shall be accepted upon the manufacturer's certification that they meet the requirements of this specification.

### **723-20 METAL STEEL CONDUIT, ZINC COATED**

**SCOPE.** This specification covers the material requirements for zinc coated rigid metal steel and intermediate metal steel conduits, used as raceways for wires or cable of an electrical system. Steel conduit may be embedded in concrete or earth; or may be used under all atmospheric conditions, including those locations classified as hazardous; and may be used in high voltage (over 600 volts) installations.

**GENERAL.** Under these requirements, either Class 1, Rigid Metal Steel Conduit or Class 2, Intermediate Metal Steel Conduit may be supplied. In addition, Class 1 and Class 2 conduits may be interchanged in the same run, providing the ends of both of the conduits are reamed, so as to create beveled edges and a smooth area over which the wires and cables will pass. Where conduit is to be jacked or exposed to the atmosphere, only Class I, Rigid Metal Steel Conduit, is permitted.

Additionally, conduit exposed to the atmosphere shall be PVC coated.

**MATERIAL REQUIREMENTS.** The zinc coated metal steel conduit shall conform to the requirements of UL 6, Class 1 - Rigid Metal Conduit: or UL 1242, Class 2 - Intermediate Metal Conduit.

All fittings, couplings and expansion fittings shall be zinc coated and shall meet the same specifications as the conduits. Condulets shall be gasketed and shall be furnished with stainless steel or brass screws for the cover. Expansion fittings shall be metallically connected for continuity of grounding on either side.

The zinc coating on the outside surfaces shall be equivalent to a minimum thickness of 0.8 mil.

**BASIS OF ACCEPTANCE.** Metal steel conduit may be accepted upon the manufacturer's certification that it meets the requirements of this section.

#### **723-21 AND 723-22 (VACANT)**

#### **723-23 P.V.C. COATED GALVANIZED STEEL CONDUIT**

**SCOPE.** This specification covers the material and quality requirements for P.V.C. coated galvanized steel conduit.

**GENERAL.** P.V.C. Coated Galvanized Steel Conduit. The hot-dipped galvanized Rigid Steel Conduit; prior to plastic coating, shall conform to N.E.M.A. Standards Publication No. RN 1, and ANSI C80.1.

Elbows in standard and special radii shall be coated as above except that no coupling will be coated with the elbow. Separate couplings will be furnished as required and ordered.

**BASIS OF ACCEPTANCE.** P.V.C. coated galvanized steel conduit will be accepted upon manufacturer's certification that it meets the requirements of this section.

#### **723-24 FLEXIBLE LIQUID-TIGHT STEEL CONDUIT**

**SCOPE.** This specification covers the material and quality requirements of flexible liquid-tight steel conduit.

**GENERAL.** The flexible liquid-tight steel conduit shall be of the size indicated on the plans. It shall conform to the requirements of Underwriters' Laboratory specification UL 360 and shall be listed with Underwriters' Laboratory Inc. Connectors furnished under this specification shall be standard liquid-tight connectors.

**BASIS OF ACCEPTANCE.** Flexible liquid-tight steel conduit will be accepted upon manufacturer's certification that it meets the requirements of this section.

#### **723-25 AND 723-26 (VACANT)**

#### **723-27 HIGH PRESSURE SODIUM VAPOR LUMINAIRES (STANDARD MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for high pressure sodium vapor luminaires.

**MATERIAL REQUIREMENTS.** The luminaires shall be of the high pressure sodium vapor type designed for use with high pressure sodium vapor lamps, color corrected or clear, and fully weatherproof.

The luminaires shall be constructed so they cover a complete self contained insect resistant and shock resistant unit. The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation. All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust-resistant finish. Weep holes shall be provided for drainage.

Easy access to the lamp and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes. The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire shall be equipped with an adjustable lamp socket to simplify beam angle setting and an appropriate refractor for the wattage and lighting distribution specified.

The luminaire casing shall be precision die-cast aluminum for the wattage of the lamps specified, and painted inside and out with a coat of baked on epoxy enamel, or polyester powder, virtually pinhole free, leaving no exposed metal. The underside of the luminaire shall be marked with the standard NEMA decal, visible from the ground, indicating the type and wattage of the lamp.

The luminaire shall contain a complete ballast assembly to which are mounted the necessary electrical components for multiple operation including ballast, solid state starting aid, capacitors, adjustable twist-lock three prong receptacle for photo-electric control when specified, and a dead back terminal board with pressure type terminals.

The ballast shall be a high power factor (exceeding 90%) 3 coil lag type (magnetic regulator) capable of operation on a 120 volt, 60 cycle, multiple circuit (unless otherwise shown on the plans) and able to operate the lamp in an open or short-circuit condition for six months without significant loss of ballast life.

The ballast assembly shall be capable of starting and operating the lamp at a temperature of -20°F.

The entire ballast assembly shall be readily removable as a single unit and utilize quick disconnect plugs.

The slipfitter shall be suitable for mounting on a 2 inch standard pipe bracket and capable of securely fastening flush to the mounting brackets without the need of separate mounting parts or rearrangement of mounting components. Leveling and clamping of the luminaire to the bracket shall be accomplished by the tightening of bolts and capable of adjusting the luminaire at least three degrees above and below horizontal. Bird shields shall be supplied and installed on all slipfitter installations.

The optical assembly shall consist of a die cast aluminum lens holder with a glass or aluminum 'Alzak' finished, hydroformed, gasketed reflector, a heat and impact resistant refractor, and a porcelain or polyester enclosed mogul socket. The mogul socket shall be equipped with lamp grip and a spring type center contact.

If a photo-electric control is specified, the receptacle shall be provided with a fully weatherproof covering that is readily removable without tools.

Luminaires shall be complete with compatible high pressure sodium lamps having the following characteristics:

% Mean lumens at 10 hours/start	90%
Warm-up time	3 to 4 minutes
Restart time	1 minute
Maximum power variance around design center	±5%
Lowest ambient starting temperature	-20 °F

The unit shall be supplied with an ANSI-IES vertical light distribution as specified on the plans. It shall be adjustable for a Type II, III or IV lateral light distribution and set at the factory for the distribution shown on the plans. For high mast installations a Type V distribution shall be provided. The downward light efficiency shall be at least 73%.

**BASIS OF ACCEPTANCE.** Acceptance of the roadway luminaire will be based on manufacturer's certification of compliance with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

### **723-28 LOW PRESSURE SODIUM VAPOR LUMINAIRES (UNDERDECK MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for Low Pressure Sodium Vapor Underdeck Luminaires.

**MATERIAL REQUIREMENTS.** The luminaire shall be of the low pressure sodium vapor type suitable for underdeck or wall mounting, designed for use with a horizontally mounted lamp, fully weatherproof and watertight. The luminaire shall operate satisfactorily with any appropriately sized low pressure sodium lamp now commercially available.

The luminaire shall be equipped with a built-in ballast, and shall be designed for operation on a 120 volt, 60 hz. multiple circuit unless otherwise shown on the plans.

The luminaire shall provide efficient even illumination and shall be optically sealed and gasketed. It shall be mechanically strong and easy to maintain. The ballast components shall be mounted in a structurally sound manner within the housing of the luminaire, with provision made for optimum heat dissipation of the ballast. The reflector, socket, terminal board, fuse and ballast components shall be readily accessible. When closed for operation, the optical assembly shall be sealed against the entry of all contaminants.

The luminaire shall withstand severe outdoor conditions due to radical seasonal changes in temperature and shall be structurally capable of operating satisfactorily in winds of 80 mph.

All exposed electrical live parts shall be protected to observe adequate safety precautions, subject to approval of the Engineer.

The whole luminaire assembly shall be completely prewired requiring only the connection of the primary circuit wires for its operation.

All components shall be corrosion resistant. Metals in contact with each other shall be compatible to prevent corrosion. Screws washers and nuts shall be stainless steel.

The luminaire housing shall be constructed of either heavy duty aluminum or heavy duty plastic and shall support the ballast, capacitor component, socket, lamp support, fuse, and terminal board. Those portions of the housing which support the ballast, and to which are connected the mounting hardware and the conduit, shall be aluminum. The underside of the housing shall be marked with the standard NEMA decal indicating the type and wattage of the lamp. All mounting hardware required for attaching the luminaire to the underdeck structure and for adjusting the luminaire about its longitudinal axis through an angle of 45 degrees from horizontal, shall be furnished with the luminaire when required. The luminaire shall be capable of being mounted flush against underdeck or, when required, suspended by rods from the underdeck. The mounting hardware shall be made of stainless steel, prevent rotation of the luminaire, and be capable of adequately supporting the luminaire in winds of 80 mph.

The reflector shall be fabricated from an aluminum alloy sheet mechanically polished and electro-chemically processed to a specular finish. It shall not darken to the extent that it cannot be wiped clean with a soft cloth.

The refractor shall be formed of clear, heat resistant, ultra-violet stabilized polycarbonate plastic, free from imperfections and capable of being removed without the use of tools.

It shall be equipped with a latching arrangement and shall be hinged to the housing of the luminaire. Provisions shall be made to prevent accidental detachment of the refractor or any other luminaire part.

The ballast shall be a modified constant wattage type with high power factor (over 90%) and capable of regulating the output power within  $\pm 5\%$  when the input voltage fluctuates  $\pm 10\%$ . The ballast and lamp shall be capable of starting and operating at ambient temperatures of  $-20^{\circ}\text{F}$ .

The lamp socket shall be bayonet type provided with a means to hold the lamp against vibration and achieve close contact between lamp and socket terminals.

A means shall be provided to reduce entrance of foreign material through the wiring opening into the optical system.

The terminal board shall be equipped with two clamp type pressure terminals for connection to the phase leg and neutral of the primary circuit. The terminals shall be properly identified for connection, with notations on terminal board, color coding, or wiring diagram.

The fuse holder shall be gasketed and provide external access to the fuse.

Photometric distribution shall be symmetric or asymmetric as specified.

**BASIS OF ACCEPTANCE.** Low pressure sodium vapor underdeck luminaires will be accepted upon the manufacturers certification that they meet the requirements of this section and are U.L. approved and on inspection by the Engineer that no damage or defects are evident.

### **723-29 HIGH PRESSURE SODIUM VAPOR LUMINAIRES (UNDERBRIDGE MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for High Pressure Sodium Vapor Luminaires (Underbridge Mount).

**MATERIAL REQUIREMENTS.** The luminaires shall be of the high pressure sodium vapor underbridge type designed for use with high pressure sodium vapor lamps.

The luminaires shall be constructed to be a complete self contained waterproof and shock resistant unit. The entire luminaire assembly shall be completely pre-wired, at the factory, requiring only the connection of the primary circuit wires to the electric power source for its operation. All metallic component parts of the luminaire shall be made of a rust-resistant alloy or coated with an approved rust-resistant finish.

Easy access to the lamp and major electrical components shall be provided requiring no special tools to gain entrance for maintenance purposes. The luminaire shall be provided with a means to prevent accidental exposure of the inner electrical components and accidental separation of the component parts.

The luminaire casing shall be precision die-cast aluminum for the wattage of the lamps specified, and marked with the standard NEMA decal, visible from the ground, indicating the type and wattage of the lamp.

The ballast shall be a high power factor (exceeding 90%) 3 coil lag type (magnetic regulator) capable of operation on a 120 volt, 60 cycle, multiple circuit (unless otherwise shown on the plans) and able to operate the lamp in an open or short-circuit condition for six months without significant loss of ballast life.

The ballast assembly shall be capable of starting and operating the lamp at a temperature of minus twenty nine degrees Celsius.

All mounting hardware required for attaching the luminaire to the underdeck structure and for adjusting the luminaire about its longitudinal axis shall be furnished with the luminaire. The luminaire shall be capable of being mounted flush against underdeck or suspended from the underdeck. The mounting hardware shall prevent rotation of the luminaire and be capable of adequately supporting the luminaire in winds of 80 mph.

The optical assembly shall consist of a die cast aluminum lens holder with a glass or aluminum 'Alzak' finished, hydroformed, gasketed reflector, a heat and impact resistant refractor, and a porcelain or polyester enclosed mogul socket. The mogul socket shall be equipped with lamp grip and a spring type center contact. Luminaires shall be complete with compatible high pressure sodium lamps having the following characteristics:



% Mean lumens at 10 hours/start	90%
Warm-up time	3 to 4 minutes
Restart time	1 minute
Maximum power variance around design center	±5%
Lowest ambient starting temperature	-20°F
Bulb finish	Clear

The unit shall be specifically designed and set to produce an ANSI-IES cutoff, type IV light distribution unless otherwise specified on the plans or ordered by the engineer. The downward light efficiency shall be at least 73%.

**BASIS OF ACCEPTANCE.** Acceptance of the underdeck luminaire will be based on manufacturer's certification of compliance with these specification requirements and on inspection by the Engineer that no damage or defects are evident.

### **723-30 MERCURY VAPOR LUMINAIRES (STANDARD MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for Mercury Vapor Luminaires.

**GENERAL.** The luminaire shall be of the mercury vapor type designed for use with a horizontally mounted mercury vapor lamp, color corrected or clear and shall be fully weatherproof. The luminaire and lamp combination shall produce Type II, III, or IV light distribution conforming to ASA Standards, and as shown on the plans. The luminaires shall be equipped with a built-in ballast for the wattage and operating voltage shown on the plans. The components comprising the assembly of the upper half of the luminaire shall include a reflector, a porcelain enclosed mogul socket, a twist-lock three prong receptacle for a photo-electric control, and a ballast.

**BASIS OF ACCEPTANCE.** Mercury vapor luminaires will be accepted upon the manufacturer's certification that they meet the requirements of this section.

### **723-31 MERCURY VAPOR LUMINAIRES (UNDERBRIDGE MOUNT)**

**SCOPE.** This specification covers the material and quality requirements for Mercury Vapor Luminaires (Underbridge Mount).

**GENERAL.** The luminaire shall be complete for surface or pendent mounting, as shown on the plans. The luminaire shall be equipped with a prismatic refractor, be shock resistant, and protected with a cast guard. The door and guard assembly shall be equipped with stainless steel pressure latches and a safety chain. The housing shall be gasketed against which the door shall seat when closed. The luminaire shall provide a maximum candela beam of 60 degrees from the vertical for roadways up to 50 feet in width, and 70 degrees for wider roadways and approximately 180 degrees horizontal spread. The ballast shall be an integral part of the luminaire and shall be capable of operating a 175 watt or 250 watt mercury vapor lamp at -20°F. The lamps shall be included with the luminaire.

**BASIS OF ACCEPTANCE.** Mercury Vapor Luminaires will be accepted upon the manufacturer's certification that they meet the requirements of this section.

### **723-32 THRU 723-39 (VACANT)**

## **723-40 CAST-IRON JUNCTION BOX**

**SCOPE.** This specification covers the material and quality requirements for Cast-Iron Junction Boxes.

**GENERAL.** Junction boxes shall be hot-dipped galvanized cast-iron with a hot-dipped galvanized cast-iron cover. The cover shall be fastened to the box with brass or stainless steel screws. The box shall be so constructed that when the installation is complete and the cover is secured the box will be water tight.

Galvanizing shall be as specified in ' 719-01, Type II.

The Manufacturer shall refer to the plans for details and dimensions.

**BASIS OF ACCEPTANCE.** Junction boxes will be accepted upon the manufacturer's certification that they meet the requirements of this section.

## **723-41 THRU 723-44 (VACANT)**

## **723-45 PRECAST REINFORCED CONCRETE FOUNDATIONS AND PULLBOXES**

**SCOPE.** This specification covers the material and quality requirements for precast concrete foundations and pullboxes.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03 shall apply.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the inside face of all pullboxes. Instead of marking the contract number on each unit they may be marked with "NYSDOT".

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis of Acceptance requirements contained in §704-03 shall apply.

## **723-46 THRU 723-49 (VACANT)**

## **723-50 PHOTOELECTRIC CONTROL**

**SCOPE.** This specification covers the material and quality requirements for Photoelectric Controls.

**MATERIALS REQUIREMENTS.** Photoelectric controls shall function to energize artificial lighting when natural lighting falls to a preset value, and to de-energize when natural lighting rises to a preset value. The photoelectric control shall be factory calibrated to energize the luminaire at approximately 3 foot-candles and de-energize at approximately 3 foot-candles. The photoelectric controls shall be adjustable by means of an outside adjustment system. The adjustment mechanism shall be easily

accessible and provide a precise foolproof light level adjustment. Photoelectric controls which cannot be adjusted while the unit is in service or have to be disconnected while making adjustments will not be acceptable.

Photoelectric controls shall be suitable for mounting in all three-pronged locking type receptacles that conform to Electrical Engineering Institute (EEI) or National Electrical Manufacturers Association (NEMA) Standard Specifications.

In the event of failure of any component of the control system, the artificial lighting shall be energized.

The housing for the photoelectric control shall be weather resistant and shall be unaffected by ultraviolet rays. A neoprene sponge gasket shall be cemented to the bottom of the base to seal out weather, dust and insects, and shall conform to EEI-NEMA Standards.

The photocell shall be hermetically sealed to prevent electrolysis from moisture. The manufacturer shall certify that each cell has had 24 hours of light preconditioning before assembly.

The photoelectric control shall be solid state and shall be capable of being faced in any direction except south. Generally, it is recommended that the photo sensitive device face north, as this affords maximum spectrum response.

The photoelectric controls shall have an operating voltage range of 105-285 volts, 50/60 cycle and shall be suitable for operation on nominal distribution voltages of 120, 208, 240, and 277 volts.

The controls shall be temperature compensated, and shall be suitable for operation from -40°F to +160°F and shall be completely unaffected by humidity. The switch mechanism shall be snap acting of sufficient capacity to adequately handle loads of 1000 watts of incandescent lighting, or 1800 volt-amperes of ballasted lighting. The photoelectric control shall be able to withstand an inrush current of a maximum of 170 amperes.

Time delay devices shall be built into the photoelectric control to prevent switching of artificial lighting due to transient lighting changes.

The photoelectric controls shall also be equipped with a built-in expulsion-type surge and lightning protection arrester.

**BASIS OF ACCEPTANCE.** Photoelectric controls will be accepted upon the manufacturer's certification that they meet the requirements of this section.

### **723-51 THRU 723-59 (VACANT)**

### **723-60 ANCHOR BOLTS**

(Last Revised May, 2019)

**SCOPE.** This specification covers the material and quality requirements for anchor bolts.

**MATERIALS REQUIREMENTS.** Anchor bolts shall meet the requirements of Class 8.8, or ASTM A449, or they may be manufactured from steel meeting the requirements of ASTM A576, Grades 1020 through 1050 inclusive, having a minimum yield strength of 50,000 psi. A hex nut, lock washer, and flat washer shall be supplied with each anchor bolt and their dimensions shall be shown on the plans. The hex nut and flat washer shall be manufactured in accordance with ASTM A563 and F436 respectively and the lock washer shall be manufactured in accordance with Table 730-22-1 Steel Fasteners. The nuts, washers and the top 12 inches of the anchor bolts shall be galvanized in accordance with the requirements for Type II or Type V galvanizing as stated in section 719-01, Galvanized Coatings and Repair Methods.

The anchor bolt dimensions shall be shown on the plans.

**SHIPPING.** Anchor bolts, hex nuts, and washers shall be shipped to the construction site at a time convenient to the masonry construction.

**BASIS OF ACCEPTANCE.** Anchor bolts will be accepted upon the manufacturer's certification that they meet the requirements of this section.

#### **723-61 THRU 723-69 (VACANT)**

#### **723-70 SINGLE CONDUCTOR CABLE**

**SCOPE.** This specification covers the material and quality requirements for single conductor cable used in highway lighting.

**MATERIAL REQUIREMENTS.** Single conductor cable shall be copper, Type THW, RHW-2, or XHHW-2 (XLP) as designated by Underwriter's Laboratory Specifications. The single conductor cable shall have heat and moisture resistant insulation for a maximum operating temperature of 165°F, in wet and dry conditions.

**BASIS OF ACCEPTANCE.** Single conductor cable shall be accepted upon the manufacturer's certification that it meets the requirements of this specification as well as being Underwriter's Laboratory approved.

#### **723-71 SINGLE CONDUCTOR DIRECT BURIAL CABLE**

**SCOPE.** This specification covers the material and quality requirements for direct burial 600V type USE cable for use in conduit or in trenches as shown on the plans and as directed by the Engineer..

**MATERIAL REQUIREMENTS.** Cable shall bear Underwriters Laboratories Label for type USE. It shall consist of copper conductor and insulation constructed to conform to ICEA (Insulated Cable Engineers Association) Pub. S-95-658 and NEMA Pub. No. 7C-70 (Nonshielded 0-2kV Cables) or their equivalent.

Cable shall consist of 7 copper strands up to and including #2 AWG and shall be constructed of 19 copper strands for sizes larger than #2 AWG.

Insulation shall be chemically cross-linked (vulcanized) polyethylene insulating compound.

Cable shall be mechanically spliced and insulated using the highest quality poured splices available for underground 600V cables.

Cable shall be factory or shop twisted in a duplex or a triplex configuration in accordance with the publications listed above or as shown in the contract documents.

**BASIS OF ACCEPTANCE.** Single Conductor Direct Burial Cable will be accepted upon the manufacturer's certification that it meets the requirements of this specification as well as being Underwriter's Laboratory approved.

#### **723-72 THRU 723-74 (VACANT)**

#### **723-75 GROUND WIRE**

**SCOPE.** This specification covers the material and quality requirements for ground wire used in highway lighting.

**MATERIAL REQUIREMENTS.** Ground wire shall be #6, soft-drawn bare copper wire, 7 strand single conductor.

**BASIS OF ACCEPTANCE.** Ground wire shall be accepted upon the manufacturer's certification that it meets the requirements of this specification.

## **723-99 FOR SITE MANAGER USE**

### **SECTION 724 - TRAFFIC SIGNALS**

(Last Revised January, 2021)

#### **724-01 SIGNAL CABLE**

**SCOPE.** This specification covers the material requirements for signal cable used in traffic signal systems wiring. Signal cable shall be installed in underground ducts or used as an aerial cable supported by a messenger cable.

**MATERIAL REQUIREMENTS.** Signal cable shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-1. The gauge and number of conductors shall be as specified in the contract documents. The conductors shall be stranded copper wire.

**BASIS OF ACCEPTANCE.** Signal cable will be accepted on the basis of a Material Certification that the product conforms to the requirements of this specification.

#### **724-02 SPAN WIRE**

**SCOPE.** This specification covers the material requirements for span wire used in the suspension of traffic signal heads and overhead traffic signal signs. Span wire may be used as a single span wire, dual span wire including a tether wire, messenger wire, or guy wire.

**MATERIAL REQUIREMENTS.** Span wire shall meet the requirements of ASTM B228, Grade 30 EHS.

**BASIS OF ACCEPTANCE.** Span wire will be accepted on the basis of a Material Certification that the product conforms to the requirements of this specification.

#### **724-03 TRAFFIC SIGNAL POLES**

**SCOPE.** This specification covers the material requirements, design criteria, and fabrication details for traffic signal poles used for vehicular and pedestrian traffic signals. Traffic signal poles are classified according to the following applications:

- A. ***Span-Wire Poles.*** Span-wire poles are used for supporting span wire to which traffic signal heads and overhead signs are attached. Span-wire poles are also referred to as strain poles.
- B. ***Mast-Arm Poles.*** Mast-arm poles consist of a vertical pole and an approximately horizontal arm to which traffic signal heads and overhead signs are attached. Mast-arm poles may be equipped with more than one mast arm.
- C. ***Post-Top-Mount Poles.*** Post-top-mount poles are used for mounting traffic signal heads directly on the top of the pole.
- D. ***Bracket-Mount Poles.*** Bracket-mount poles are used to support traffic signal heads and other

devices bracketed from, or attached to, the side of the pole.

- E. **Monotube Poles.** Monotube poles consist of two vertical poles (one on each side of the intersection) and an approximately horizontal shaft which is connected to the vertical poles. Traffic signal heads and overhead signs are then attached to the horizontal shaft.

## **MATERIAL REQUIREMENTS**

**General.** The following materials shall be used for traffic signal pole fabrication. Span wire, mast arm, and monotube poles shall be galvanized steel. Post-top-mount and bracket-mount poles shall be galvanized steel or aluminum. Acceptable aluminum materials are those contained in the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2013 version)*.

The following are the acceptable steel materials for the traffic signal pole components:

1. **Traffic Signal Poles.** Traffic Signal Poles shall be made of one of the following:
  - ASTM A500, Grade B, or ASTM A501.
  - ASTM A53, Grade B pipe.
  - ASTM A53, Grade B pipe, with a minimum yield of 48,000 psi guaranteed by the manufacturer and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
  - ASTM A252, Grade 2 or Grade 3.
  - ASTM A252, Grade 2, with a minimum yield of 48,000 psi guaranteed by the manufacturer and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
  - ASTM A572, Grades 40, 50, 60 or 65.
  - ASTM A595, Grade A.
  - ASTM A618, Grade I, II or III.
  - ASTM A588.
  - ASTM A513, with a minimum yield strength of 36,000 psi guaranteed by the manufacturer and documented by the submission of certified copies of physical tests performed on the lots of material from which the poles were manufactured.
  - ASTM A1008/A1008M Grade 60 Class 2.
  - ASTM A1011/A1011M Grade 60 Class 2.
  - Span wire sleeve shall be of the same material as the main pole.
  - Flange connection for mast arm and monotube poles shall be the same material as the horizontal shaft.
2. **Base Plates.** The base plates for traffic signal poles shall be made of one of the following:
  - ASTM A27 Grade 65-35, mild to medium strength carbon steel castings.
  - ASTM A36.
  - ASTM A588.
  - ASTM A572, Grade 40, 50, 60 or 65.
  - ASTM A633 (Any Grade).
3. **Connection Devices (excluding anchor bolts).** All hardware, including thimble eyebolts and circumferential pole clamps, shall meet the requirements of one of the following:
  - ASTM A36.
  - ASTM A588.
  - ASTM F3125/F3125M.

4. **Pole Caps and Anchor Bolt Covers.** Pole caps for traffic signal poles shall be galvanized steel, galvanized cast iron, aluminum, or zinc alloy AG40A. Anchor bolt covers (if specified in the contract documents) shall be galvanized steel, galvanized cast iron, or aluminum.

## DESIGN CRITERIA

- A. **General.** Traffic signal poles shall be designed in accordance with AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (2013 version)* except as modified herein. The following elements shall be designed for the most critical orientation of the loads applied to a traffic signal pole:

- All tubular segments of the structure.
- Hand hole reinforcement and other hole reinforcements.
- Devices used to connect cable (e.g., span wire and tether wire) to pole.
- Base plates.
- Mast arm to pole connections.
- Multiple mast arms connected to one vertical pole.
- Horizontal shaft to pole connections of monotube traffic signal pole structure.
- Centered flange connection(s) of a two or three -section horizontal shaft of monotube traffic signal pole structure
- All traffic signal pole mounting hardware including anchor bolts, washers, anchor bars, and hex nuts.
- Span wire steel sleeve (for span wire poles with wall thickness less than 0.25inch).

The design calculations and working drawings shall be approved, stamped, and signed by a Professional Engineer.

All necessary holes in the pole below the load attachment point, and greater than 0.6875 inch in diameter, shall be made by the manufacturer only, and reinforced according to the fabrication details, contract documents, and the New York State Steel Construction Manual.

**Wind Loads.** All traffic signal poles and attachments shall be designed to withstand loads generated from maximum wind speeds below:

Nassau and Suffolk Counties – 120 mph

Counties in New York City: New York (Manhattan), Kings (Brooklyn), Bronx, Richmond (Staten Island), and Queens – 110 mph

All other counties – 90 mph

**B. Span-Wire Poles.** Cross-sectional shape of span wire poles shall be round or multi-sided (minimum six-sides).

1. **Design Load.** The design load and allowable stresses for span-wire poles shall be in accordance with AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2013 version)*, including group IV load, and applied at a point 18 inches from the top of the pole.

Maximum Deflection - Shall be computed at a point 18 inches from the top of the pole.

Deflection shall be a maximum of 0.6 inch per foot of pole length. There shall be a maximum deflection rate of 0.6 inch per 100 pounds of load suspended from span wire.

2. **Dimensions.** Span-wire poles shall conform to the following requirements:

- Minimum Wall Thickness - Shall be 0.125 inch.
- Maximum Pole Diameter at the Base – Shall be 1.50 inch per foot of pole length.

3. **Span-Wire Connecting Hardware.** For multi-sided poles or fluted poles, the connecting hardware shall be a galvanized thimble eyebolt or a circumferential pole clamp. For round poles, the correct device shall be thimble eyebolts. The design strength shall be 70% of yield strength of the connecting device. The yield strength of the connecting device shall be determined using a cable load aligned 85 degrees to the vertical axis of the pole. A span wire steel sleeve shall be welded to the span wire pole (in the area where thimble eyebolt will be located) prior to drilling the hole for the thimble eyebolt, if the pole's wall thickness is less than 0.25inch.

**C. Mast-Arm Poles.** Cross-sectional shape of both vertical pole and horizontal arm (mast arm) shall be round, fluted, or multi-sided (minimum six sides) and shall have the same cross-sectional shape.

1. **Design Loads.** Each part of the mast arm pole structure shall be designed for the combination of loads producing the maximum effect using unit stresses increased for the material and group loads as described in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2013 version)*.

Maximum Deflection at Design Load:

Pole - 0.5 inch per foot of length.

Mast Arm - 0.5 inch per foot of length.

2. **Mast-Arm Section.** Mast arms shall be continuously tapered from pole connection to the tip. When all dead loads are applied, the resting position of the end of the mast arm shall be as per the standard sheets.
3. **Mast-Arm to Pole Connection.** The mast arm shall be secured to the pole by at least four bolts. The mast arm shall be equipped with a flange plate. The flange plate shall have vertical and horizontal gusset plates (top and bottom and at each side) welded to the butt end of the mast arm. A mating flange plate shall be attached to the pole using vertical and horizontal gusset plates (top and bottom and at each side). Flange plates on poles and mast arms shall have a de-burred hole with a smooth cable guide for wiring.
4. **Dimensions.** Mast arms and poles shall conform to the following requirements: Minimum Wall Thickness - 0.125 inch. Maximum Diameter at base of pole or arm.: Pole - 1.50 inch per foot of length. Mast Arm - 0.7 inch per foot of length. Maximum length of mast arm shall be sixty-five (65) feet.
5. **Poles with Multiple Mast Arms.** Poles with multiple mast arms shall be designed and constructed in accordance with the mast-arm configuration in the contract documents.

**D. Post-Top-Mount and Bracket-Mount Poles.** Cross-sectional shape of poles shall be round or fluted.

1. **Design Loads.** These traffic signal poles shall be designed for the combination of loads producing the maximum effect using unit stresses increased as indicated for the material and group loads as described in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2013 version)*. If these poles are not protected by a guiderail and are constructed of galvanized steel, then they shall be designed for installation with breakaway transformer bases.

2. **Dimensions.** These poles shall conform to the following requirements:

Minimum Wall Thickness - 0.125 inch.

Maximum Diameter at base of pole:

Pole - 0.7 inch per foot of length.



**E. Monotube Poles.** Cross-sectional shape of both vertical pole and horizontal shaft shall be round, fluted or multi-sided (minimum six sides) and shall have the same cross-sectional shape.

**1. Design Loads.** Each part of the monotube pole structure shall be designed for the combination of loads producing the maximum effect using unit stresses increased for the material and group loads as described in AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (2013 version)*.

Maximum Deflection at Design Load:

Pole - 0.5 inch per foot of length.

Horizontal Shaft - 0.5 inch per foot of length.

**2. Horizontal Shaft.** Shall have a maximum of three sections and all sections shall be un-tapered.

**3. Horizontal Shaft to Pole Connections.** The horizontal shaft shall be secured to the vertical poles by at least four bolts at each end of horizontal shaft. The horizontal shaft shall be equipped with a flange plate on each end of shaft with vertical and horizontal gusset plates (top and bottom and at each side) welded to the butt ends of the horizontal shaft. A mating flange plate shall be attached to the poles using vertical and horizontal gusset plates (top and bottom and at each side). Flange plates shall have a de-burred hole with a cable guide for wiring.

**4. Horizontal Shaft Center Connection(s).** Any horizontal shaft center connection shall be a flange type connection and secured by at least four bolts. Each flange shall have four equally spaced gusset plates. Flange plates shall have a de-burred hole with a cable guide for wiring. Alternative center connection designs shall be pre-approved by the Engineer before manufacture.

**5. Dimensions.** Horizontal shafts and poles shall conform to the following requirements:

- Minimum Wall Thickness – 0.125 inch.
- Maximum Diameter at base of pole or horizontal shaft.:
- Pole - 1.50 inch per foot of length.
- Horizontal Shaft - 0.7 inch per foot of total length.

#### FABRICATION DETAILS

**A. Welding.** All welding shall be performed by certified welders and in accordance with the New York State Steel Construction Manual. Field welding shall be at a minimum. Galvanizing of poles shall be performed after all welding is completed.

**B. Base Plates and Hardware.** The traffic signal pole base plate shall be welded to the pole by the pole manufacturer in accordance with the pole fabrication details, contract documents, and the New York State Steel Construction Manual.

Base plates shall be galvanized (after being welded to pole) in accordance with §719-01 *Galvanized Coatings and Repair Method, Type I*.

Flange plates on horizontal shafts shall be circular on the outside and shall have a de-burred hole with a smooth cable guide for wiring. The horizontal shaft for a monotube pole structure may be constructed in one, two or three sections. For two sections the flanged connection shall be located at the center of the span. For three sections the two flanged connections shall be located at the one-third points from the ends.

**C. Traffic Signal Poles.** Finished traffic signal poles shall be galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods, Type I*.

All traffic signal poles, excluding those intended for breakaway transformer base mounting (i.e., post-top-mount or bracket-mount poles), shall be equipped with hand holes. Hand holes shall be centered approximately 2 feet above the base plate end of the pole. The maximum hand hole size shall not exceed 4 inches by 6.5 inches. Poles shall be equipped with a grounding terminal accessible through the hand hole. Grounding terminals are not necessary if there is no hand hole required.

Holes for wiring fittings shall consist of a pipe coupling of the diameter specified in the contract documents and shall be shop installed when possible. Hand holes and holes for wiring fittings located near the base of the pole shall be reinforced with steel at least equal in area to the steel removed from the pole for the fabrication of the hole. All holes shall be de-burred before starting the galvanizing process.

A steel sleeve is required at the location of the thimble eyebolt for span wire pole when the span wire pole wall thickness at that location is less than 0.25 inches. In such a case the steel sleeve shall be welded to the span wire pole, centered in the area where thimble eyebolt will be located, prior to drilling the hole for the thimble eyebolt.

Traffic signal poles shall be fabricated in any of the following shapes and styles:

1. **Round, Continuously Tapered Construction.** Poles shall be fabricated with one longitudinal seam only which shall be continuously welded and ground or rolled flush. Poles shall have a uniform wall thickness and shall taper uniformly starting at the butt end and decreasing in diameter at a rate between 0.25 and 0.5 inch per three feet of length.
2. **Round, Step-Tapered Construction.** (Applicable only to span wire poles) Poles shall be fabricated from round pipe sections with one longitudinal seam only. Poles shall be joined by a hot-swaged shrink fit and continuously seal welded to prevent entrance of water. Starting at the butt end, poles shall achieve a tapered effect of 0.25 to 0.5 inch per 3 feet of length by use of decreasing diameter, round-pipe sections of uniform wall thickness and shall be concentric in relation to one another.
3. **Multi-sided, Continuously Tapered Construction.** The multi-sided pole shall conform to the requirements set forth above under Round, Continuously Tapered Construction except that it shall have no more than 2 longitudinal seams which shall be continuously welded and ground or rolled flush. Poles with 5 sides or less shall not be allowed.
4. **Round, Un-tapered Construction.** Span wire poles, all sections of monotube pole structures and vertical portion of mast arm poles may be round un-tapered with one longitudinal seam only and have uniform wall thickness which shall be continuously welded and ground or rolled flush. When un-tapered, vortex shedding shall be considered where applicable.
5. **Fluted Construction.** Poles of fluted construction shall be round (tapered or un-tapered) and shall have a uniform wall thickness with one longitudinal seam only which shall be continuously welded and ground or rolled flush.

Span wire poles shall be of the same type and style at a new or rebuilt signalized intersection.

**D. Mast Arms and Horizontal Shafts of Monotube Poles.** Horizontal mast arms shall be continuously tapered starting at the pole connection and decreasing in diameter at a rate between 0.25 and 0.5 inch per three feet of length. All vertical and horizontal members of the monotube pole structure shall be un-tapered.

**E. Pole Marking**

1. **Span-Wire Poles.** The following information shall be stamped on the top of the base plate or ground sleeve with at least 0.5-inch tall letters to such a depth as to be clearly visible after galvanizing:

<b>Desired Information</b>	<b>Example</b>
Manufacturers Name or Logo	-
Month and Year of Manufacture	1109
Design Moment at top of foundation	10 ft kips
Minimum Yield Strength	50 ksi

2. **Vertical Mast-Arm Poles and Monotube Poles.** The following information shall be stamped on the top of the base plate or ground sleeve with at least 0.5-inch tall letters to such a depth as to be clearly visible after galvanizing.

<b>Desired Information</b>	<b>Example</b>
Manufacturers Name or Logo	-
Month and Year of manufacture	1009
Design Moment at top of foundation	12 ft kips
Minimum Yield Strength	55 ksi

3. **Horizontal Mast-Arms and Shaft of Monotube Poles.** The following information shall be stamped on the mast arm or horizontal shaft of monotube pole structure with at least 0.5-inch tall letters to such a depth as to be clearly visible after galvanizing.

<b>Desired Information</b>	<b>Example</b>
Manufacturers Name or Logo	-
Month and Year of Manufacture	1009
Design Moment at top of foundation	12 ft kips
Minimum Yield Strength	50 ksi

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approval List shall prepare and submit copies of drawings, specifications, and test reports to the Director of the Materials Bureau. The review process requires a minimum of 180 calendar days.

**BASIS OF ACCEPTANCE.** Acceptance of all Traffic Signal Poles covered by this specification shall be based on the following:

- Submission of fabrication details and design calculations for each pole, intended for a worst-case configuration of the loads, as specified in the contract documents, signed and sealed by a Professional Engineer.
- Submission of the manufacturer's certificate of compliance with these specification requirements and the approved fabrication details.
- In addition, for all spanwire, mast arm and monotube poles, mill certification of all structural materials shall be submitted to the Engineer.

A Material Certification (either manufacturer's certification or material supplier's certification) shall be provided for every traffic signal pole order placed by the Department or its contractor(s). Pole dimensions (i.e.: mast arm mounting height, span wire pole height, etc.) shall be confirmed before traffic signal pole orders are placed by the Department or its contractors.

## **724-04 VEHICULAR AND PEDESTRIAN TRAFFIC SIGNAL HEADS**

**SCOPE.** This specification covers the material requirements, design criteria, and fabrication details for Vehicular and Pedestrian Traffic Signal Heads consisting of one or more traffic signal sections. A Standard Traffic Signal Section is a complete unit for illuminating one lens and consists of a housing, lens, reflector, and lamp receptacle (Type I traffic signal section does not have a lens, reflector, or lamp receptacle). Vehicular and Pedestrian Traffic Signal Heads shall be made of Aluminum or Polycarbonate material. The following types of vehicular and pedestrian traffic signal heads are currently available:

- A. *Aluminum Vehicular Traffic Signal Head.*** Manufactured in die cast aluminum material and available in sizes that accept standard size vehicular traffic signal indications.
- B. *Polycarbonate Vehicular Traffic Signal Head.*** Manufactured in polycarbonate material and available in sizes that accept standard size vehicular traffic signal indications.
- C. *Aluminum Pedestrian Traffic Signal Head.*** Manufactured in die cast aluminum material and available in sizes that accept standard size pedestrian traffic signal indications.
- D. *Polycarbonate Pedestrian Traffic Signal Head.*** Manufactured in polycarbonate material and available in sizes that accept standard size pedestrian traffic signal indications.

**MATERIAL REQUIREMENTS.** Vehicular and pedestrian traffic signal heads are manufactured using die cast aluminum or polycarbonate materials. Multi-section traffic signal heads shall be constructed of traffic signal sections of the same type of material (either aluminum or polycarbonate) – there shall be no mixing of material types within the same traffic signal head. The following shall be used for vehicular and pedestrian traffic signal head fabrication:

- A. *Aluminum.*** All aluminum vehicular and pedestrian traffic signal heads shall be die-cast of aluminum in accordance with the requirements of ASTM B85, Alloy A360, A380, or AA13.
- B. *Polycarbonate.*** All polycarbonate vehicular and pedestrian traffic signal heads shall be made of injection-molded, ultraviolet resistant, heat stabilized, flame retardant polycarbonate resin, capable of withstanding a 70ft-lb impact without fracture or permanent deformation, and shall be resistant to heat. The temperature rating for polycarbonate traffic signal heads shall be -35 to 165 °F.
- C. *Wiring.*** All wiring shall consist of No. 14 AWG or larger stranded copper wire with thermoplastic insulation and a 600-volt rating.

## **DESIGN CRITERIA**

**Wind Loads.** All traffic signal heads, mounting brackets, attachments and fittings shall be designed for a wind load generated from maximum wind speeds below:

Nassau and Suffolk Counties – 120 mph

Counties in New York City: New York (Manhattan), Kings (Brooklyn), Bronx, Richmond (Staten Island), and Queens – 110 mph  
All other counties – 90 mph

**Snow and Ice Load.** All traffic signal heads, mounting brackets, attachments and fittings shall be designed for snow and ice load pressure depending on geographic location of installation.

**Electrical Characteristics.** All traffic signal heads shall be designed for operation on 115 volts  $\pm$ 30 volts, 60 Hertz, single phase AC power unless otherwise indicated.

#### **A. Aluminum Vehicular Traffic Signal Heads**

- 1. Traffic Signal Section.** The traffic signal section wall thickness shall be 0.0625 inch (minimum). Each traffic signal section shall be arranged with openings in the top and bottom, so that it may be rotated about a vertical axis between waterproof supporting brackets or trunnions and shall be capable of being securely fastened at increments of not more than 7 degrees of rotation. The top and bottom of each traffic signal section shall have integrally cast locking rings or other provisions to provide positive interlocking and indexing. The top and bottom of each traffic signal section shall be provided with tees or crosses equipped with pipe-plug knobs or caps which can be removed to assist in wiring. Flat arms or spiders will be accepted as an alternative for use on the bottom of adjustable traffic signals.

Each traffic signal section shall be designed so that additional sections may be added. The construction shall permit the assembly of different size traffic signal sections of the same manufacturer. The construction shall permit joining smaller size traffic signal sections either above or below larger size traffic signal sections.

All traffic signal sections shall be rigidly and securely fastened together into one unitized, weather-resistant traffic signal face. An adjustable traffic signal head shall consist of two or more traffic signal faces fastened to, and supported by, a pipe assembly and suitable entrance fitting.

- 2. Doors.** The traffic signal section door shall be provided with four visor mounting holes located equidistant about the lens opening to allow the mounting of the visor in either a vertical or horizontal position. The holes shall be drilled and tapped and provided with stainless steel mounting screws. Neoprene gasketing shall be provided between the body of the traffic signal section and the door. The door shall be suitably hinged and shall be forced tightly against the gasket and the housing by simple stainless-steel locking devices. All other exterior hardware such as hinge pins, lens clips, etc., shall be of stainless steel. The locking device shall be capable of being operated without the use of tools. Hinges shall be arranged to allow convenient relamping. On the outside of the door, there shall be a rim encircling the lens opening to prevent any light leakage between optical systems.
- 3. Visors.** The traffic signal section visor shall be separate and removable from the door. The visor shall be held in place by stainless steel fastenings attached to the door in such a manner as to prevent the possibility of any light leakage between the door and visor which might be discernible from the side. Traffic signal section visors shall be of sheet aluminum, at least 0.050 inches thick, and shall mount to the traffic signal head with four slotted mounting tabs which align with the mounting screws on the housing door. Unless otherwise specified in the contract documents, all traffic signal heads shall be provided with cap-type visors. The underside of visors and the entire surface of louvers or fins used in front of traffic signal lenses shall be painted a flat black to minimize light reflection to the sides of the traffic signal heads. Visors shall tilt down from the horizontal a minimum of 3.5 degrees and shall be at

least 9.5 inches in length for larger diameter lenses and 7 inches in length for smaller diameter lenses.

4. **Terminal Block.** Each traffic signal face shall be equipped with a 5-point heat-resistant terminal block. The terminal block shall have five terminals with connectors for receptacle leads and screw terminals for field wires.

The individual terminal blocks in the separate traffic signal faces of a traffic signal head shall be interconnected. In one face of each multi-face traffic signal head there shall be an additional 9-position terminal block to which all field wires are connected. All socket leads of all traffic signal faces shall terminate at this 9-position terminal block.

5. **Dust-Tight Optical System.** The dust-tight optical system shall be properly gasketed to exclude dust and dirt from the reflecting surface of the reflector and the inner surface of the lens. Gaskets shall be placed between the reflector and supporting member, and between the reflector holder and the inner surface of the lens. This system applies to incandescent lamps only.

#### **B. Polycarbonate Vehicular Traffic Signal Heads**

1. **Traffic Signal Section.** The traffic signal section shall have a wall thickness of 0.100 inch (minimum). The housing and door shall be one-piece construction. All traffic signal sections are to be designed in the same manner. When using different sized traffic signal sections in combination, all traffic signal sections shall match each other.

The top and bottom opening of each traffic signal section shall have integral, serrated bosses that will provide positive positioning of the traffic signal head to eliminate undesirable rotation or misalignment of the traffic signal head between traffic signal sections. Each opening accommodates standard 1.5-inch diameter pipe fittings and brackets.

2. **Doors.** Doors shall be hinged by two lugs and mounted to the housing using stainless steel pins. The door of each traffic signal section shall be one piece with a minimum thickness of 0.0625 inch.

A neoprene gasket shall be provided between the body of the traffic signal section and the door. The doors shall be forced tightly against the gasket and traffic signal section by simple stainless-steel locking devices. A slotted, air-cored, neoprene lens gasket shall provide a positive seal between the lens and the traffic signal door and between the lens and the reflector holder.

The gasket shall be an unbroken circular gasket with a "U" shaped cross section. The gasket and lens shall be held tightly into the door by four stainless steel clips and screws that shall allow easy removal of the lens and gasket from the door without removal of the door in the field.

3. **Visors.** Visor shall be one piece with a minimum thickness of 0.0625 inch. The rear edge of the visor shall be provided with four mounting lugs for attaching the visor to the door. The inside of the visor shall be dull black in color. All traffic signal heads shall be provided with cap-type visors unless otherwise directed.

4. **Terminal Block.** Each traffic signal face shall be equipped with a five-point heat-resistant terminal block. The terminal block shall have five terminals with connectors for receptacle leads and screw terminals for field wires.

The individual terminal blocks in the separate traffic signal faces of a traffic signal head shall be interconnected. In one face of each multi-face traffic signal head, there shall

be an additional 9- position terminal block to which all field wires are connected. All socket leads of all traffic signal faces shall terminate at this 9-position terminal block.

**5. Dust-Tight Optical System.** The optical system shall be properly gasketed to exclude dust and dirt from the reflecting surface of the reflector and the inner surface of the lens. Gaskets shall be placed between the reflector and supporting member and between the reflector holder and the inner surface of the lens. This system applies to incandescent lamps only.

**C. Aluminum Pedestrian Traffic Signal Heads.** In addition to applicable items in *ALUMINUM VEHICULAR TRAFFIC SIGNAL HEADS*, the following requirements apply to Aluminum Pedestrian Traffic Signal Heads:

Pedestrian traffic signal construction and indications shall conform to the requirements of “Pedestrian Traffic Control Signal Indications” published by the Institute of Transportation Engineers, with the following modifications:

- Unless otherwise specified, the head shall be a two-section unit.
- Traffic signal sections are available in two sizes to accept a 12-inch square LED module or a 16-inch x 18-inch LED module.
- Traffic signal heads shall be supplied with No. 14 AWG, or larger, color coded wiring harness and a four-position, barrier-type terminal block.

**D. Polycarbonate Pedestrian Traffic Signal Heads.**

In addition to applicable items in *POLYCARBONATE VEHICULAR TRAFFIC SIGNAL HEADS*, the following requirements apply to Polycarbonate Pedestrian Traffic Signal Heads:

Pedestrian traffic signal construction and indications shall conform to the requirements of “Pedestrian Traffic Control Signal Indications” published by the Institute of Transportation Engineers, with the following modifications:

- Unless otherwise specified, the head shall be a two-section unit.
- Traffic signal sections are available in two sizes to accept a 12-inch square LED module or a 16-inch x 18-inch LED module.
- Traffic signal head shall be supplied with No. 14 AWG, or larger, color coded wiring harness, and a four- position, barrier-type terminal block.

## FABRICATION DETAILS

### *Powder Coating.*

**1. Coating Powder.** All aluminum traffic signal heads, visors and metallic mounting attachments shall be coated with a thermosetting, super durable polyester coating powder formulated for use over aluminum surfaces for high performance in the harsh exterior exposures of New York State. The powder coating film shall possess the following properties:

Property	Value
Film Thickness	3-4 mils
Outdoor Weatherability	Excellent (>1,000 hrs ASTM B117 Salt Fog).
UV Resistance	Excellent
Pencil Hardness	HB-2H, ASTM D3363
Direct Impact Resistance	80-160 in-lb
Adhesion	5A/5B, ASTM D3359
Color (Outside Surfaces of Signal Head)	Dark Green (Fed. Color. No. 595A, Color 14056)
Color (Inside of visor)	Black

Gloss	Satin or Gloss
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1. **Pretreatment of Aluminum Surfaces.** All exterior and interior surfaces of the aluminum signal head, visors and metallic mounting attachments shall be prepared for powder coating using a non-chrome conversion coating. It shall be either a reactive or dried-in-place chrome-free coating to be used as a pre-treatment.
2. **Pretreatment Process.** The aluminum surfaces shall be subjected to a thorough cleaning process and a non-chrome conversion coating shall then be applied. Rinse stages shall be employed as necessary to remove residual chemicals and contamination. A multi-stage system shall be employed to perform cleaning, rinsing, conversion coating, and passivating rinse/finish individually. No less than three (3) stages shall be employed.
3. **Passivating Final Rinse.** A passivating final rinse shall be applied. The conversion coating and passivating final rinse shall be specifically formulated for use on aluminum surfaces. They shall prevent corrosion of the aluminum, promote adhesion and be compatible with the chosen coating powder.
4. **Powder Application.** The coating powder shall be applied to a dry surface. Any remaining rinse water shall be allowed to dry or forced dry prior to powder coating. If forced drying is employed the component shall be allowed to cool down to a temperature dictated by the powder manufacturer that will not cause issues with the powder coating. The powder shall be applied electrostatically. Compressed air used for coating shall be supplied at the proper dew point and free of oil, rust or other microscopic contaminants.
5. **Curing.** The powder coating shall then be cured in an oven. The metal temperature and dwell time required for proper cure of the coating shall be as recommended by the coating powder manufacturer and shall be strictly complied with.

**Latching Devices.** All stainless-steel latching devices shall not be painted.

**BASIS OF ACCEPTANCE.** Vehicular and Pedestrian Traffic Signal Heads will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

## 724-05 TRAFFIC SIGNAL LED INDICATIONS

**SCOPE.** This specification covers the material requirements for LED indications used in vehicular and pedestrian traffic signal heads.

**General.** Ball and Single Arrow LED indications in these specifications are described as NYSDOT Standard or Type “A” indications. NYSDOT Standard LED indications are compatible with model 215 current monitors, whereas NYSDOT Type “A” LED indications are not compatible with model 215 current monitors. Pedestrian LED indications and Bi-Modal Arrow LED indications are described as NYSDOT Type “A” only. Pedestrian LED indications manufactured for NYSDOT can be used with NYS specified cabinets that have or do not have a model 215 current monitor. All LED indications shall be designed, built, and tested per Institute of Transportation Engineers (ITE) performance specifications titled “Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement” and “Pedestrian Traffic Control Signal Indicators – Light Emitting Diode (LED) Signal Modules.”



**MATERIAL REQUIREMENTS.** The material requirements for all traffic signal LED indications covered under this specification shall conform to the ITE specifications mentioned above. Refer to NYSDOT Transportation Management Equipment Specifications (TMES) Chapter 17 for detailed traffic signal LED indication specifications.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Qualified Product List (QPL) shall submit samples of the product, together with an operation and maintenance manual for each manufacturing or supply location, to the Traffic Signal Laboratory, 16 Avis Drive, Latham, New York 12110. Refer to Chapter 1 of the NYSDOT Transportation Management Equipment Specifications (TMES) for instructions.

The Department will test the submitted samples in accordance with these specifications and Department instructions. The review process requires a minimum of 180 calendar days. Test procedures are available from the Traffic Signal Laboratory upon request. Upon approval, the name of the manufacturer and the product will be placed on the Qualified Product List (QPL).

**BASIS OF ACCEPTANCE.** Traffic Signal LED indications will be accepted on the basis of the product's part number and manufacturer's name appearing on the Qualified Product List (QPL) and a Material Certification that the product is the same as the one appearing on the Qualified (QPL) Product List and that it conforms to the requirements of this specification. NYSDOT requires a test report (for each lot produced by the manufacturer) from the private testing facility that performs the QA sample testing. NYSDOT Traffic Signal Lab will provide the QA sample testing procedure to the testing facility.

## **724-06 TRAFFIC SIGNAL HEADS WITH OPTICALLY PROGRAMMED INDICATIONS**

**SCOPE.** This specification covers the material requirements, design criteria, and fabrication details for traffic signal heads with optically programmed indications. Traffic signal heads with optically programmed indications shall permit the visibility zone of the indication to be determined optically. The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis. No indication shall result from external illumination nor shall one light unit illuminate a second. This assembly shall include incandescent lamps or LED indications.

**MATERIAL REQUIREMENTS.** Hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather-resistant rubber gaskets. The temperature rating for traffic signal heads with optically programmed indications shall be -35 to 165 °F. The following materials shall be used for fabrication of traffic signal heads with optically programmed indications:

- A. Aluminum.** All aluminum traffic signal heads with optically programmed indications shall be die cast of aluminum in accordance with the requirements of ASTM B85, Alloy A360, A380, or AA13.
- B. Wiring.** All wiring shall consist of No. 14 AWG or larger stranded copper wire with thermoplastic insulation and a 600-volt rating.

## **DESIGN CRITERIA**

**Wind Loads.** Traffic signal heads, mounting brackets, attachments and fittings shall be designed for a wind load pressure generated from maximum wind speeds below:

Nassau and Suffolk Counties – 120 mph

Counties in New York City: New York (Manhattan), Kings (Brooklyn), Bronx, Richmond (Staten Island), and Queens – 110 mph

All other counties – 90 mph

**Snow and Ice Load.** Traffic signal heads, mounting brackets, attachments and fittings shall be designed for snow and ice load pressure depending on geographic location of installation.

**Electrical Characteristics.** All equipment shall be designed for operation on 115 volts  $\pm$ 30 volts, 60 Hertz, single phase AC power unless otherwise indicated.

**A. Aluminum Traffic Signal Section.** The traffic signal section and lens holder shall be predrilled for backplates and visors. A traffic signal section face shall be of unitized sectional construction. The traffic signal section wall thickness shall be 0.0625 inch (minimum). Each traffic signal section housing shall be die-cast with reinforcing ribs on all sides for extra structural rigidity. Each traffic signal section shall be arranged with openings in the top and bottom so that it may be rotated about a vertical axis between waterproof supporting brackets or trunnions and shall be capable of being securely fastened at increments of not more than 7 degrees of rotation. The top and bottom of each traffic signal section shall have integrally cast locking rings or other provisions to provide positive interlocking and indexing. The top and bottom of each traffic signal section shall be provided with tees or crosses equipped with pipe-plug knobs or caps which can be removed to assist in wiring. Flat arms or spiders will be accepted as an alternative for use on the bottom of adjustable signals. Each traffic signal section shall be so designed that additional sections may be added (3 sections maximum). All traffic signal sections shall be rigidly and securely fastened together into one weather-resistant traffic signal face. An adjustable traffic signal head shall consist of two or more traffic signal faces fastened to, and supported by, a pipe assembly and suitable entrance fitting.

1. **Doors.** The traffic signal section front door shall be provided with four visor mounting holes located equidistant about the lens opening to allow the mounting of the visor in either a vertical or horizontal position. The holes shall be drilled and tapped and provided with stainless steel mounting screws. Neoprene gasketing shall be provided between the body of the traffic signal section and the front and rear doors. The doors shall be suitably hinged and shall be forced tightly against the gasket and the housing by simple stainless-steel locking devices. All other exterior hardware such as hinge pins, lens clips, etc. shall be of stainless steel. The locking device shall be capable of being operated without the use of tools. Hinges shall be arranged to allow convenient relamping. On the outside of the front door, there shall be a rim encircling the lens opening to prevent any light leakage between optical systems.
2. **Visors.** The traffic signal section visor shall be separate and removable from the front door. The visor shall be held in place by stainless steel fastenings attached to the door in such a manner as to prevent the possibility of any light leakage between the door and visor which might be discernible from the side. Visors shall be of sheet aluminum, at least 0.050 inches, and shall mount to the traffic signal head with four slotted mounting tabs which align with the mounting screws on the housing door. Unless otherwise specified in the contract documents, all traffic signal heads shall be provided with cap-type visors. The underside of visors shall be painted a flat black to minimize light reflection to the sides of the traffic signals. Visors shall tilt down from the horizontal a minimum of 3.5 degrees and shall be at least 9.5 inches in length for large diameter lenses and 7 inches in length for small diameter lenses.
3. **Terminal Blocks.** Each signal section shall have a 5-position barrier block with 15 quick disconnect terminals for easy socket lead assembly and 5 screw clamp terminals for field wiring.

**B. Optical System.** The optical system shall accommodate projection of diverse selected indicia to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer. The projected indication shall conform to ITE transmittance and chromaticity standards. The optical system shall be properly gasketed to exclude dust and dirt from the reflecting surface of the reflector and the inner surface of the lens. Gaskets shall be placed between the reflector and supporting member and between the reflector holder and the inner surface of the lens.

The following components shall comprise the optical system:

1. **Lamp and Lamp Collar.** The lamp shall be nominal 150-watt, 115-volt AC, Par-56, three prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The signal section shall also be capable of accepting 12" LED indications if incandescent lamps are not requested.
2. **Optical Limiter-Diffuser.** The diffusing element may be discrete or integral with the convex surface of the optical limiter. The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 900 to 1200 feet distant and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass.
3. **Objective Lens.** The objective lens shall be a high resolution, planar, incremental lens hermetically sealed within a flat laminate of weather-resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90-degree orientation about the optical axis without displacing the primary image. Colored lenses shall be bonded to Fresnel optical lens for programmability. Each lens is sealed to the door by a specially extruded EPDM gasket. The lens shall be held in place by four stainless lens clips and four stainless steel screws to create a moisture and dust proof seal.

**C. Assembly.** The traffic signal head shall mount to standard 1.5-inch fittings as a single traffic section, as a multiple section face, or in combination with other traffic signals heads. The traffic signal section shall be provided with an adjustable connection that permits 2-degree incremental tilting from 0 to 10 degrees above or below the horizontal axis while maintaining a common vertical axis through couplers and mounting. Terminal connection shall permit external adjustment about the mounting axis in 5-degree increments. The traffic signal head shall be constructed such that it can be installed with ordinary tools and serviced with no tools.

Attachments such as visors, backplates, and adapters shall conform and readily fasten to existing mounting surfaces without affecting weatherproof ability and light integrity of the traffic signal head.

The traffic signal head shall be arranged for rigid mounting to a mast arm, monotube traffic signal pole structure, or a dual span-wire assembly. It is important for proper operation of the traffic signal head that it be mounted as rigidly as practical to maintain its optical orientation with the roadway. In cases where span wires are used, it should be securely fastened to the lower span (or tether) wire.

**D. Electrical.** The lamp fixture shall comprise a separately accessible housing (rear door of traffic

signal section) and integral lamp support, indexed ceramic socket, and self-aligning, quick-release lamp retainer. Electrical connection between the case and lamp housing shall be accomplished with an interlock assembly which disconnects the lamp housing when opened.

Each traffic signal section shall include a covered terminal block for clip or screw attachment of field wires.

Concealed No.14 AWG or larger stranded and coded copper wires shall interconnect all sections to permit field connection within any section.

**E. Photo Controls.** Each traffic signal section shall include integral means for regulating its intensity between limits as a function of individual background illumination. Lamp intensity shall be at least 97% of uncontrolled intensity at 1,000 fc and shall reduce to 1.4 fc  $\pm$ 2% of maximum at less than 1 fc over the applied voltage and ambient temperature range. Response shall be proportional and essentially instantaneous to any detectable increase from darkness to 1,000 fc and damped for any decrease from 1,000 fc.

The intensity controller shall comprise an integrated directional-light sensing and regulating device interposed between lamp and field wires. The device shall be responsive over an applied voltage of 95 to 130 VAC, 60 Hz, temperature range of -35 to 165 °F, may provide phase-controlled output voltage, and shall have a nominal open-circuit terminal impedance of 1,500 ohms. The Photo Control shall not produce sufficient electrical noise or interference to adversely affect the operation of solid-state electronic equipment used on traffic signal controllers and associated auxiliary equipment. The Photo Control shall not cause false tripping of conflict monitors.

## FABRICATION DETAILS

### *Powder Coating*

- 1. Coating Powder.** All aluminum traffic signal heads, visors and metallic mounting attachments shall be coated with a thermosetting, super durable polyester coating powder formulated for use over aluminum surfaces for high performance in the harsh exterior exposures of New York State. The powder coating film shall possess the following properties:

Property	Value
Film Thickness	3-4 mils
Outdoor Weatherability	Excellent (>1,000 hrs ASTM B117 Salt Fog).
UV Resistance	Excellent
Pencil Hardness	HB-2H, ASTM D3363
Direct Impact Resistance	80-160 in-lb
Adhesion	5A/5B, ASTM D3359
Color (Outside Surfaces of Signal Head)	Dark Green (Fed. Color. No. 595A, Color 14056)
Color (Inside of visor)	Black
Gloss	Satin or Gloss

- 2. Pretreatment of Aluminum Surfaces.** All exterior and interior surfaces of the aluminum signal head, visors and metallic mounting attachments shall be prepared for powder coating using a non-chrome conversion coating. It shall be either a reactive or dried-in-place chrome-free coating to be used as a pre-treatment.

- 3. Pretreatment Process.** The aluminum surfaces shall be subjected to a thorough cleaning process and a non-chrome conversion coating shall then be applied. Rinse stages shall be

employed as necessary to remove residual chemicals and contamination. A multi-stage system shall be employed to perform cleaning, rinsing, conversion coating, and passivating rinse/finish individually. No less than three (3) stages shall be employed.

4. **Passivating Final Rinse.** A passivating final rinse shall be applied. The conversion coating and passivating final rinse shall be specifically formulated for use on aluminum surfaces. They shall prevent corrosion of the aluminum, promote adhesion and be compatible with the chosen coating powder.
5. **Powder Application.** The coating powder shall be applied to a dry surface. Any remaining rinse water shall be allowed to dry or forced dry prior to powder coating. If forced drying is employed the component shall be allowed to cool down to a temperature dictated by the powder manufacturer that will not cause issues with the powder coating. The powder shall be applied electrostatically. Compressed air used for coating shall be supplied at the proper dew point and free of oil, rust or other microscopic contaminants.
6. **Curing.** The powder coating shall then be cured in an oven. The metal temperature and dwell time required for proper cure of the coating shall be as recommended by the coating powder manufacturer and shall be strictly complied with.

**Latching Devices.** All stainless-steel latching devices shall not be painted.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approval List shall prepare and submit copies of drawings, specifications, and test reports to the Director of the Materials Bureau. The review process requires a minimum of 180 calendar days.

**BASIS OF ACCEPTANCE.** Acceptance of signal heads with optically programmed indications will be based on the manufacturer's certificate of compliance with these specification requirements.

## 724-07 TRAFFIC SIGNAL HEAD MOUNTING HARDWARE AND BACKPLATES

**SCOPE.** This specification covers the material requirements, design criteria, and fabrication specifics for traffic signal head backplates and traffic signal head mounting hardware used for attaching vehicular and pedestrian traffic signal heads to span wires, mast arms, horizontal shaft of monotube traffic signal poles, and post-top or vertical pole bracket mounts.

### MATERIAL REQUIREMENTS

#### A. **Traffic Signal Head Mounting Hardware.**

1. **Reinforcing Plates.** Reinforcing plates (minimum 7 ga x 4-inch-wide galvanized steel) shall be supplied for all polycarbonate vehicular traffic signal head assemblies with three or more traffic signal sections. Reinforcing plates shall be installed in the bottom section of post-top mounted traffic signal heads and in the top-most section of all others. Reinforcing plates shall have a centered hole sized for the attachment of traffic signal head mounting hardware and be shaped to maximize the coverage of surface area within the signal section. The shape may vary between manufacturers.
2. **Suspension Components.** All traffic signal heads suspension components (e.g., brackets, clamps, trunnions, arms, elbows, tees, crosses, and pipe caps) shall be made of one of the following materials:

- a) **Malleable Iron.** Malleable iron material shall be made in accordance with ASTM A47.
  - b) **Steel Pipe.** Steel pipe shall be made in accordance with ASTM A53.
3. **Fasteners.** The following items shall be made of non-magnetic stainless steel, Type 303 or 304, in accordance with ASTM A763/A763M.
    - All set screws.
    - The U/J-bolts, rivet, and their related nuts, washers, and cotter pin in the span-wire clamp.
    - The eyebolt, rivet, tightening bolt, and their related nuts, washers, and cotter pin in the balance adjuster.
  4. **Pipe Arms.** Pipe arms shall be made of steel pipe in accordance with ASTM A53/A53M.

**B. Backplates.** Backplates shall be constructed of aluminum, polycarbonate or high impact ABS plastic with a minimum thickness of 0.125 inches and shall have a flat black finish. The backplate shall have a 3-inch-wide retro reflective yellow border (Type XI (eleven) weather resistant prismatic sheeting) applied.

The backplates shall have appropriate mounting hardware and when mounted shall not obstruct the signal head door openings. The backplates shall have a five (5) inch border around the entire signal head assembly, shall follow the shape of the signal head assembly, and shall be non-louvered. The yellow reflective tape shall border the entire perimeter of the backplate and be a width of three (3) inches. The temperature rating for all backplates shall be - 35 to 165 °F. The reflective tape shall not separate from the backplate within this temperature range.

All backplates shall be compatible with the traffic signal head assembly so there are no modifications needed to the backplate.

## DESIGN CRITERIA

**A. Traffic Signal Head Mounting Hardware.** Center junction hubs shall have a threaded opening on the top and sides. The bottom of the hub shall be fully open, except for the necessary thickness of the housing, and shall be securely covered by a flat plate of weather-resistant design. The plate shall be held in place by a minimum of two screws. Center junction hubs shall be provided with a square or hex-drive set screw on all threaded openings. The top opening shall be provided with two set screws located 90 degrees to each other. Center junction hubs shall have an opening of at least 3.5 inches in diameter for round openings. Center junction hubs shall have a side length of at least 3.5 inches for rectangular openings.

Tees and crosses shall have threaded openings to accept the necessary pipe arm and traffic signal head connections. Tees and crosses shall have at least one additional threaded opening to facilitate wiring. The additional opening shall be closed with a threaded metal (eg: malleable iron or steel) pipe cap. All threaded openings on the tees and crosses shall be provided with a square or hex-drive set screw. Threaded openings on pipe arms shall be tapered. Threaded openings on other pipe fittings shall be pipe straight threads.

Flat arms or spiders shall be provided for the bottom of multi-face traffic signal heads. Bottom hardware shall be omitted for multi-face, one-section, traffic signal head assemblies. Connections between the bottom of the traffic signal heads and the arm or spider shall be flanged or threaded to provide a locking, weather-resistant connection.

Traffic signal heads for mast arm or monotube mounting shall be furnished with a mount consisting of upper and lower horizontal arms attaching to the top and bottom of the traffic signal section. The

horizontal arms shall attach to a vertical member which in turn clamps to the mast arm (or horizontal shaft of monotube pole structure). The mast arm (or horizontal shaft of monotube pole structure) mount shall have provisions for adjusting the vertical, angular, and rotational positioning of the traffic head in relation to the mast arm (or horizontal shaft of monotube pole structure) so that it is plumb, in line with other traffic signal heads, and properly oriented in relation to traffic.

Wiring shall be concealed within the mount. All wiring contact points shall be de-burred to prevent accidental electrical shorting due to insulation removal by sharp edges of metal.

Post-top traffic signal heads shall be furnished with a post-top type slip-fitter mounting. Vertical pole bracket-mount traffic signal heads shall be equipped with upper and lower horizontal brackets equipped with pole plates for attachment to the pole with stainless steel bands.

## FABRICATION DETAILS

### A. Powder Coating

1. **Coating Powder.** All aluminum traffic signal heads, visors and metallic mounting attachments shall be coated with a thermosetting, super durable polyester coating powder formulated for use over aluminum surfaces for high performance in the harsh exterior exposures of New York State. The powder coating film shall possess the following properties:

Property	Value
Film Thickness	3-4 mils
Outdoor Weatherability	Excellent (>1,000 hrs ASTM B117 Salt Fog).
UV Resistance	Excellent
Pencil Hardness	HB-2H, ASTM D3363
Direct Impact Resistance	80-160 in-lb
Adhesion	5A/5B, ASTM D3359
Color (Outside Surfaces of Signal Head)	Dark Green (Fed. Color. No. 595A, Color 14056)
Color (Inside of visor)	Black
Gloss	Satin or Gloss

2. **Pretreatment of Aluminum Surfaces.** All exterior and interior surfaces of the aluminum signal head, visors and metallic mounting attachments shall be prepared for powder coating using a non-chrome conversion coating. It shall be either a reactive or dried-in-place chrome-free coating to be used as a pre-treatment.
3. **Pretreatment Process.** The aluminum surfaces shall be subjected to a thorough cleaning process and a non-chrome conversion coating shall then be applied. Rinse stages shall be employed as necessary to remove residual chemicals and contamination. A multi-stage system shall be employed to perform cleaning, rinsing, conversion coating, and passivating rinse/finish individually. No less than three (3) stages shall be employed.
4. **Passivating Final Rinse.** A passivating final rinse shall be applied. The conversion coating and passivating final rinse shall be specifically formulated for use on aluminum surfaces. They shall prevent corrosion of the aluminum, promote adhesion and be compatible with the chosen coating powder.
5. **Powder Application.** The coating powder shall be applied to a dry surface. Any remaining rinse water shall be allowed to dry or forced dry prior to powder coating. If

forced drying is employed the component shall be allowed to cool down to a temperature dictated by the powder manufacturer that will not cause issues with the powder coating. The powder shall be applied electrostatically. Compressed air used for coating shall be supplied at the proper dew point and free of oil, rust or other microscopic contaminants.

6. **Curing.** The powder coating shall then be cured in an oven. The metal temperature and dwell time required for proper cure of the coating shall be as recommended by the coating powder manufacturer and shall be strictly complied with.

**Latching Devices.** All stainless-steel latching devices shall not be painted.

- B. **Assembly.** Traffic signal heads shall be arranged for mounting on span wires, mast arms, horizontal shaft of monotube traffic signal poles, post tops or vertical pole bracket mounts as specified in the contract documents. For span-wire mounting, the traffic signal head shall be provided with a span-wire clamp, balance adjuster and wire outlet fitting. The span-wire clamp shall consist of a shoe, lock bar, two "U" or "J" bolts, and a rivet with cotter pin, nuts, washers, etc., as necessary. The balance adjuster shall consist of a body with threaded eyebolt, a tightening bolt, and a rivet with cotter pin, nuts, washers, etc., as necessary. The wire outlet fitting shall have a continuous opening of a minimum nominal diameter of 1.50 inches for insertion of traffic signal head wiring. The upper opening shall have a weatherproof, insulating-composition cover that provides for the insertion of the wiring. The cover shall be securely mounted to the fitting. The bottom opening shall be threaded and provided with two square or hex-drive set screws located at 180 degrees to each other. The bottom of the fitting shall have integral cast serrations, shall be notched and provided with a serrated locking ring, or shall be provided with a slotted check nut and serrated locking ring. The head shall be assembled so that it hangs plumb. Backplates (with reflector tape) shall be installed on all vehicular traffic signal heads for new or rebuilt traffic signal locations.

- a. **Single-Face Traffic Signal Head Mounting Hardware.** Mounting hardware for a signal-face traffic signal head shall include a 1.5-inch galvanized nipple with cast iron head, gasket, and steel washer for the connection between the wire outlet fitting and the top of the traffic signal head. A metal weather-resistant cap/plug shall be provided for the unused hole in the bottom of the head. The cap/plug shall be of a threaded or flanged design.

- b. **Multi-Face Traffic Signal Head Mounting Hardware.** Mounting hardware for multi-face (2, 3, and 4-face) traffic signal heads shall include a center junction hub and pipe arms with tee or cross-end connectors. Galvanized steel reinforcing plates shall be provided with all polycarbonate traffic signal heads. Tee and cross-end connectors shall be notched for, and supplied with, a serrated locking ring. A 1.5-inch galvanized nipple with cast iron head, gasket, and steel washer shall be supplied for the connection between the tee or cross-end connector and the top of the traffic signal head. Tees and crosses will not be accepted in place of the center junction hub.

**BASIS OF ACCEPTANCE.** Traffic signal head mounting hardware and backplates will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

## 724-08 SHIELDED COMMUNICATION CABLE



**SCOPE.** This specification covers the material requirements for shielded communication cable for use with traffic signal systems.

**MATERIAL REQUIREMENTS.** Shielded communication cable shall conform to the requirements of the International Municipal Signal Association (IMSA) specification 20-2 for polyethylene-insulated, polyethylene-jacketed communication cable with electrical shielding. The gauge and number of conductors shall be as specified in the contract documents. The conductors shall be stranded copper wire.

**BASIS OF ACCEPTANCE.** Shielded communication cable will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

#### **724-09 SIGNAL CABLE WITH INTEGRAL MESSENGER**

**SCOPE.** This specification covers the material requirements for signal cable with integral messenger for use with traffic signal systems and for aerial installations.

**MATERIAL REQUIREMENTS.** Signal Cable with Integral Messenger shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-3. The gauge and number of conductors shall be as specified in the contract documents. The conductors shall be stranded copper wire.

**BASIS OF ACCEPTANCE.** Signal Cable with Integral Messenger will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification

#### **724-10 SHIELDED COMMUNICATION CABLE WITH INTEGRAL MESSENGER**

**SCOPE.** This specification covers the material requirements for shielded communication cable with integral messenger for use with traffic signal systems and for aerial installations.

**MATERIAL REQUIREMENTS.** Shielded Communication Cable with Integral Messenger shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-4. The gauge and number of conductors shall be as specified in the contract documents. The conductors shall be stranded copper wire.

**BASIS OF ACCEPTANCE.** Shielded Communication Cable with Integral Messenger will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

#### **724-11 TRAFFIC SIGNAL POLE MOUNTING HARDWARE**

**SCOPE.** This specification covers the material requirements, design criteria, and fabrication details for traffic signal pole mounting hardware.

##### **MATERIAL REQUIREMENTS**

- A. Anchor Bolts.** Traffic Signal Pole Anchor Bolts shall meet the requirements of ASTM F1554 Grades 36, or Grade 55.
- B. Hex Nuts.** Hex nuts shall meet the requirements of ASTM A563. The type and grade of steel for hex nuts shall be compatible (to prevent galling) and of comparable strength to the steel used for the anchor bolts.

**C. Washers.** Washers shall meet the requirements of ASTM F436.

**D. Anchor Plates.** Anchor Plates used on anchor bolts shall meet the requirements of ASTM A36 (A709 Grade 36). These plates shall be either drilled and tapped to accept the threaded anchor bolts or drilled 0.125 inches larger than anchor bolt diameter.

**DESIGN CRITERIA.** Anchor bolts shall be long enough to embed 30 bolt diameters (minimum) into the concrete foundation. “L” bends shall not be allowed on the embedded end of anchor bolts. The number of anchor bolts and the bolt circle diameter shall be determined by the pole manufacturer unless specified in the contract documents. Each anchor bolt shall be equipped with four hex nuts, drilled or tapped steel anchor plates, and two flat washers for attaching the pole to the foundation.

**FABRICATION DETAILS.** All anchor bolts, hex nuts, and flat washers required for each pole shall be supplied by the Contractor. Anchor bolts shall be installed using double nuts and anchor plates, or threaded anchor plates, and shall be designed by the pole manufacturer. Hex nuts, flat washers, and at least the top 12 inches of anchor bolts shall be hot-dipped galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods, Type II*.

Flat washers will not be required when the holes on the base plate are within the following tolerances:

- Hole diameter not more than 0.125 inch greater than the bolt diameter, and bolt diameter less than 1 inch.
- Hole diameter not more than 0.25 inch greater than the bolt diameter, and bolt diameter equal to or greater than 1 inch.
- Hole diameter not more than 0.375 inch greater than the bolt diameter, and bolt diameter equal to or greater than 2 inches.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approval List shall prepare and submit copies of drawings, specifications, and test reports to the Director of the Materials Bureau. The review process requires a minimum of 180 calendar days.

**BASIS OF ACCEPTANCE.** Acceptance of traffic signal pole mounting hardware will be based on the manufacturer's certificate of compliance with these specification requirements.

## **724-12 TRAFFIC SIGNAL VEHICLE AND PEDESTRIAN DETECTORS**

**SCOPE.** This specification covers the material requirements for traffic signal vehicle and pedestrian detectors.

**MATERIAL REQUIREMENTS.** All traffic signal vehicle and pedestrian detectors shall be constructed of components capable of withstanding extreme hot and cold temperatures (temperature range of -35 to 165 °F), as well as extreme weather conditions such as sleet, snow, freezing rain, high winds, etc., and be corrosion resistant. Vehicle detectors shall be capable of detecting every type of vehicle that is licensed to date. All electrical components shall be UL listed or recognized for their intended function. Refer to the NYSDOT Transportation Management Equipment Specifications (TMES) for details as follows: Chapter 3 for Loop Detectors, Chapter 10 for Microwave Detectors, and Chapter 11 for Ultrasonic Detectors.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved Products List (APL) shall submit samples of the product, together with an operation and maintenance manual for each manufacturing or supply location, to the Traffic Signal Laboratory, 16 Avis Drive, Latham, New York 12110. Refer to Chapter 1 of the NYSDOT Transportation Management Equipment Specifications (TMES) for instructions.

The Department will test the submitted samples in accordance with these specifications and Department instructions. The review process requires a minimum of 180 calendar days. Test procedures are available

from the Traffic Signal Laboratory upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved Products List.

**BASIS OF ACCEPTANCE.** Traffic Signal Detectors will be accepted on the basis of the product's part number with manufacturer's name appearing on the Approved Products List and a Material Certification that the product is the same as the one appearing on the Approved Products List and that it conforms to the requirements of this specification. Refer to the Transportation Management Equipment Specifications (TMES).

#### **724-13 ELECTRICAL SERVICE DISCONNECT/GENERATOR TRANSFER SWITCHES**

**SCOPE.** This specification covers the material requirements and design criteria for electrical service disconnect/generator transfer switches.

**MATERIAL REQUIREMENTS.** Electrical service disconnect/generator transfer switch enclosures shall be constructed of 0.060-inch stainless steel and shall be rated NEMA 3R. Refer to NYSDOT Transportation Management Equipment Specifications (TMES) Chapter 20 for detailed electrical service disconnect/generator transfer switch specifications.

**DESIGN CRITERIA.** Electrical service disconnect/generator transfer switches shall be designed to satisfy the ANSI requirements for service equipment and for generator transfer switches. All electrical components shall be UL listed or recognized for their intended function.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved Products List shall submit samples of the product, together with an operation and maintenance manual for each manufacturing or supply location, to the Traffic Signal Laboratory, 16 Avis Drive, Latham, New York 12110. Refer to Chapter 1 of the NYSDOT Transportation Management Equipment Specifications (TMES) for instructions.

The Department will test the submitted samples in accordance with these specifications and Department instructions. The review process requires a minimum of 180 calendar days. Test procedures are available from the Traffic Signal Laboratory upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved Products List.

**BASIS OF ACCEPTANCE.** Electrical disconnect/generator transfer switches will be accepted on the basis of the product's part number with manufacturer's name appearing on the Approved Products List and a Material Certification that the product is the same as the one appearing on the Approved Products List and that it conforms to the requirements of this specification.

#### **724-14 ELECTRICAL SERVICE CABLE**

**SCOPE.** This specification covers the material requirements for electrical service cable used in providing electrical service to traffic signal heads. Electrical service cable shall be installed in underground ducts, used as an aerial cable supported by a messenger cable, or used as a direct burial cable.

**MATERIAL REQUIREMENTS.** Electrical service cable shall meet the requirements of the National Electrical Code and be Underwriters Laboratory approved. Electrical service cable shall be rated for 600-volt service and the conductors shall be stranded copper wire. The number and size of the conductors shall be in accordance with the contract documents. Electrical service cable shall conform to the requirements of the International Municipal Signal Association (IMSA) Specification 20-5.

**BASIS OF ACCEPTANCE.** Electrical service cable will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

#### **724-15 FIRE PRE-EMPTION TELL-TALE LIGHT**

**SCOPE.** This specification covers the material requirements and design criteria for a fire pre-emption tell-tale light.

**MATERIAL REQUIREMENTS.** The fire pre-emption tell-tale light shall consist of a Xenon flash tube rated at 10.76 MIx and 2000 hours life.

**DESIGN CRITERIA.** The flash rate shall be 60 to 80 flashes per minute. The fire pre-emption tell-tale light shall be capable of normal operation from -35 to 165 °F. The fire pre-emption tell-tale light shall be contained in a vandal-resistant, weatherproof housing and mounted with a blue-colored, heat-resistant, shatterproof globe. It shall be visible through 360 degrees horizontally. The fire pre-emption tell-tale light shall operate from a 115 VAC, 60 Hz single phase power source.

**BASIS OF ACCEPTANCE.** Acceptance of the fire pre-emption tell-tale light shall be based on the manufacturer's certification of compliance with these specification requirements. Acceptance of material may require supplementary sampling and testing at the discretion of the Materials Bureau. A Material Certification (either manufacturer's certification or material supplier's certification) shall be provided for every order placed by the Department or its contractor(s).

#### **724-16 THRU 724-19 (VACANT)**

#### **724-20 INDUCTANCE LOOP WIRE**

**SCOPE.** This specification covers the material requirements for wire used in inductance loop vehicle detectors.

**MATERIAL REQUIREMENTS.** Loop wire shall be one conductor No. 14 AWG wire loosely encased in a tube in conformance to the requirements of the International Municipal Signal Association (IMSA) Specification 51-5.

**BASIS OF ACCEPTANCE.** Inductance Loop Wire will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

#### **724-21 SHIELDED LEAD-IN CABLE**

**SCOPE.** This specification covers the material requirements for shielded lead-in cable used with inductance loop vehicle detectors.

**MATERIAL REQUIREMENTS.** Shielded lead-in cable shall consist of No. 14 AWG conductors in conformance to the requirements of the International Municipal Signal Association (IMSA) Specification 50-2.

**BASIS OF ACCEPTANCE.** Shielded lead-in cable will be accepted on the basis of a Material Certification that specifies that the product conforms to the requirements of this specification.

**724-22 ROADWAY LOOP EMBEDDING SEALER**

**SCOPE.** This specification covers the material requirements for Roadway Loop Embedding Sealer which is used when installing inductance loops.

**MATERIAL REQUIREMENTS.** Roadway Loop Embedding Sealer shall be used to encapsulate Traffic Signal Loop Wires embedded in highway materials. The sealer shall be applied cold and may be a one or two component system, the viscosity of which shall be sufficient to allow the material to be either poured or placed under pressure and fully encapsulate the loop wires. The sealer shall be curable at temperatures of 40 °F and above.

When the sealer is bonded to common paving materials, it shall have sufficient strength and resiliency to withstand stresses due to vibrations and differences in expansion and contraction as a result of temperature changes or traffic conditions. The sealer shall be compatible with the sheathing or covering of loop inductance wires.

The material shall meet the requirements of either the Flexible or Hard designation in Table 724-22-1. Materials designated Flexible require a 180-degree mandrel bend test @ 80 °F with no breaking as part of the accelerated weathering testing.

<b>TABLE 724-22-1 ROADWAY LOOP EMBEDDING SEALER PROPERTIES</b>					
<b>Property</b>	<b>Test Method</b>	<b>Flexible</b>		<b>Hard</b>	
		<b>Min.</b>	<b>Max.</b>	<b>Min.</b>	<b>Max.</b>
Hardness, Shore	ASTM D2240	A15	A40	A50	D65
Pot Life @70 °F, minutes	NYSDOT 724-40E	15	---	15	---
Curing Time (tack free surface) @ 70 °F, hours	NYSDOT 724-40E	---	2	---	2
Tensile Strength, psi	ASTM D412	50	---	400	---
Elongation, percent	ASTM D412	150	---	20	---
Water Absorption, percent	NYSDOT 724-40E	---	1.0	---	1.0
Adhesion to Asphalt Concrete, lbs	NYSDOT 724-40E	200	---	500	---
Adhesion to Concrete, lbs	NYSDOT 724-40E	50	---	300	---
Extension, inches	NYSDOT 724-40E	1/4	---	1/8	---
Accelerated Weathering (Flexible requires additional bend test)	NYSDOT 724-40E	No cracking, checking, chalking, or shrinking			

**Chemical Resistance.** Cured sealer shall be resistant to most chemicals and solvents including salts, acids, hydrocarbons, etc.

Packaged stability of each component in original unopened containers, stored in temperatures between 32 and 100 °F, shall be a minimum of six months.

**BASIS OF APPROVAL.** Applications for approval of Roadway Loop Embedding Sealer shall be submitted to the Materials Bureau by the manufacturer accompanied by a one-gallon sample of the product and all pertinent sealer information including, but not limited to, manufacturer's test results, application procedures, and safety data sheet. Upon approval by the Materials Bureau, the name of the product will be placed on the Approved List based on the compatibility of the sealer with the pavement material.

**BASIS OF ACCEPTANCE.** Roadway Loop Embedding Sealer will be accepted on the basis of the product appearing on the Approved List and a Material Certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **724-23 PEDESTRIAN PUSH BUTTON**

**SCOPE.** This specification covers the material requirements and fabrication details for a pedestrian push button compliant with the Public Rights-of-Way Accessibility Guidelines (PROWAG) – Piezo design pushbutton.

**MATERIAL REQUIREMENTS.** The push button body shall be powder-coated (dark green) aluminum construction and be 3 inches in diameter. The push button shall be 2 inches in diameter and of stainless-steel construction. Refer to NYSDOT Transportation Management Equipment Specifications (TMES) Chapter 21 for detailed specifications of the Piezo pedestrian pushbutton. The temperature rating for pedestrian push buttons shall be -35 to 165 °F.

### **DESIGN CRITERIA**

- A. General Requirements.** An audible “beep” shall sound when activating the push button. The push buttons shall have a minimum operating life of 100 million actuations. The push buttons shall be compatible with all 242 DC Isolation Units.  
The pedestrian push button station shall incorporate the pedestrian push button and informational sign into a complete assembly by mounting them to a coated, cast aluminum frame.
- B. Functional Requirements.** The push button shall be equipped with a pole mounting housing to enable mounting the button to a flat or a convex surface. The push button unit shall be PROWAG compliant (Piezo type). The push button shall require a force of 1 to 3 lbs. to activate. The pedestrian station frame shall be constructed to accept the Piezo pushbutton as well as a 9-inch x 15-inch pedestrian information sign.
- C. Mechanical Construction Requirements.** The switch shall be piezo-driven and solid state with essentially no moving parts. The push button and pedestrian pushbutton frame shall be highly vandal-resistant and shall be assembled with tamper-resistant, stainless steel hardware.
- D. Electrical Requirements.** The push button shall operate at voltages of 15 to 24 VDC or 12 to 24 VAC. The push button shall have an ON Resistance of 10 Ohms when the button is activated and placing a call. A standby current of 10 micro amps is typical. The push button shall require two conductors to be run from the traffic signal cabinet to the push button to operate. The push button shall have a solid-state electronic piezo switch rated for 100 million cycles with no moving plunger or moving electrical contacts.
- E. Environmental Operations.** The push button shall be capable of continuous operation over a temperature range of -35 to 165 °F. The push button shall operate immediately after being completely immersed in water for 5 minutes.

### **FABRICATION DETAILS**

#### **Powder Coating**

- 1. Coating Powder.** All aluminum traffic signal heads, visors and metallic mounting

attachments shall be coated with a thermosetting, super durable polyester coating powder formulated for use over aluminum surfaces for high performance in the harsh exterior exposures of New York State. The powder coating film shall possess the following properties:

Property	Value
Film Thickness	3-4 mils
Outdoor Weatherability	Excellent (>1,000 hrs ASTM B117 Salt Fog).
UV Resistance	Excellent
Pencil Hardness	HB-2H, ASTM D3363
Direct Impact Resistance	80-160 in-lb
Adhesion	5A/5B, ASTM D3359
Color (Outside Surfaces of Signal Head)	Dark Green (Fed. Color. No. 595A, Color 14056)
Color (Inside of visor)	Black
Gloss	Satin or Gloss

2. **Pretreatment of Aluminum Surfaces.** All exterior and interior surfaces of the aluminum signal head, visors and metallic mounting attachments shall be prepared for powder coating using a non-chrome conversion coating. It shall be either a reactive or dried-in-place chrome-free coating to be used as a pre-treatment.
3. **Pretreatment Process.** The aluminum surfaces shall be subjected to a thorough cleaning process and a non-chrome conversion coating shall then be applied. Rinse stages shall be employed as necessary to remove residual chemicals and contamination. A multi-stage system shall be employed to perform cleaning, rinsing, conversion coating, and passivating rinse/finish individually. No less than three (3) stages shall be employed.
4. **Passivating Final Rinse.** A passivating final rinse shall be applied. The conversion coating and passivating final rinse shall be specifically formulated for use on aluminum surfaces. They shall prevent corrosion of the aluminum, promote adhesion and be compatible with the chosen coating powder.
5. **Powder Application.** The coating powder shall be applied to a dry surface. Any remaining rinse water shall be allowed to dry or forced dry prior to powder coating. If forced drying is employed the component shall be allowed to cool down to a temperature dictated by the powder manufacturer that will not cause issues with the powder coating. The powder shall be applied electrostatically. Compressed air used for coating shall be supplied at the proper dew point and free of oil, rust or other microscopic contaminants.
6. **Curing.** The powder coating shall then be cured in an oven. The metal temperature and dwell time required for proper cure of the coating shall be as recommended by the coating powder manufacturer and shall be strictly complied with.

**Latching Devices.** All stainless-steel latching devices shall not be painted.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approval Products List shall prepare and submit copies of drawings, specifications, and test reports to the Director of the Materials Bureau. The review process requires a minimum of 180 calendar days.

**BASIS OF ACCEPTANCE.** Pedestrian push button and sign will be accepted on the basis of the product appearing on the Approved Products List and a Material Certification that the product conforms to this specification.

## **724-24 PEDESTRIAN PUSH BUTTON STATION**

**SCOPE.** This specification covers the material requirements, design criteria and fabrication details for a pedestrian push button and pedestrian station frame, compliant with the Public Rights-of-Way Accessibility Guidelines (PROWAG).

**MATERIAL REQUIREMENTS.** The push button body shall be powder-coated (dark green) aluminum construction and be 3 inches in diameter. The push button shall be 2 inches in diameter and of stainless-steel construction. The push button mounting frame (for the pedestrian push button station) shall be powder-coated (dark green) aluminum construction and shall have an integral sign frame for a 9-inch x 15-inch sign. Refer to NYSDOT Transportation Management Equipment Specifications (TMES) Chapter 21 for detailed specifications of the Piezo pedestrian pushbutton.

### **DESIGN CRITERIA**

**A. General Requirements.** An audible “beep” shall sound when activating the push button. The push buttons shall have a minimum operating life of 100 million actuations. The push buttons shall be compatible with all 242 DC Isolation Units.

The pedestrian push button station shall incorporate the pedestrian push button and informational sign into a complete assembly by mounting them to a coated, cast aluminum frame.

**B. Functional Requirements.** The push button shall be equipped with a pole mounting housing to enable mounting the button to a flat or a convex surface. The push button unit shall be PROWAG compliant (Piezo type). The push button shall require a force of 1 to 3 lbs. to activate. The pedestrian station frame shall be constructed to accept the Piezo pushbutton as well as a 9-inch x 15-inch pedestrian information sign.

**C. Mechanical Construction Requirements.** The switch shall be piezo-driven and solid state with essentially no moving parts. The push button and pedestrian pushbutton frame shall be highly vandal-resistant and shall be assembled with tamper-resistant, stainless steel hardware.

**D. Electrical Requirements.** The push button shall operate at voltages of 15 to 24 VDC or 12 to 24 VAC. The push button shall have an ON Resistance of 10 Ohms when the button is activated and placing a call. A standby current of 10 micro amps is typical. The push button shall require two conductors to be run from the traffic signal cabinet to the push button to operate. The push button shall have a solid-state electronic piezo switch rated for 100 million cycles with no moving plunger or moving electrical contacts.

**E. Environmental Operations.** The push button shall be capable of continuous operation over a temperature range of -35 to 165 °F. The push button shall operate immediately after being completely immersed in water for 5 minutes.

### **FABRICATION DETAILS**

#### **Powder Coating**



1. **Coating Powder.** All aluminum traffic signal heads, visors and metallic mounting attachments shall be coated with a thermosetting, super durable polyester coating powder formulated for use over aluminum surfaces for high performance in the harsh exterior exposures of New York State. The powder coating film shall possess the following properties:

Property	Value
Film Thickness	3-4 mils
Outdoor Weatherability	Excellent (>1,000 hrs ASTM B117 Salt Fog).
UV Resistance	Excellent
Pencil Hardness	HB-2H, ASTM D3363
Direct Impact Resistance	80-160 in-lb
Adhesion	5A/5B, ASTM D3359
Color (Outside Surfaces of Signal Head)	Dark Green (Fed. Color. No. 595A, Color 14056)
Color (Inside of visor)	Black
Gloss	Satin or Gloss

2. **Pretreatment of Aluminum Surfaces.** All exterior and interior surfaces of the aluminum signal head, visors and metallic mounting attachments shall be prepared for powder coating using a non-chrome conversion coating. It shall be either a reactive or dried-in-place chrome-free coating to be used as a pre-treatment.
3. **Pretreatment Process.** The aluminum surfaces shall be subjected to a thorough cleaning process and a non-chrome conversion coating shall then be applied. Rinse stages shall be employed as necessary to remove residual chemicals and contamination. A multi-stage system shall be employed to perform cleaning, rinsing, conversion coating, and passivating rinse/finish individually. No less than three (3) stages shall be employed.
4. **Passivating Final Rinse.** A passivating final rinse shall be applied. The conversion coating and passivating final rinse shall be specifically formulated for use on aluminum surfaces. They shall prevent corrosion of the aluminum, promote adhesion and be compatible with the chosen coating powder.
5. **Powder Application.** The coating powder shall be applied to a dry surface. Any remaining rinse water shall be allowed to dry or forced dry prior to powder coating. If forced drying is employed the component shall be allowed to cool down to a temperature dictated by the powder manufacturer that will not cause issues with the powder coating. The powder shall be applied electrostatically. Compressed air used for coating shall be supplied at the proper dew point and free of oil, rust or other microscopic contaminants.
6. **Curing.** The powder coating shall then be cured in an oven. The metal temperature and dwell time required for proper cure of the coating shall be as recommended by the coating powder manufacturer and shall be strictly complied with.

**Latching Devices.** All stainless-steel latching devices shall not be painted.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved Products List shall submit samples of the product, together with an operation and maintenance manual for each manufacturing or supply location, to the Traffic Signal Laboratory, 16 Avis Drive, Latham, New York 12110. Refer to Chapter 1 of the NYSDOT Transportation Management Equipment Specifications (TMES) for instructions.

The Department will test the submitted samples in accordance with these specifications and Department instructions. The review process requires a minimum of 180 calendar days. Test procedures are available from the Traffic Signal Laboratory upon request. Upon approval, the name of the manufacturer and the product will be placed on the Approved Products List.

**BASIS OF ACCEPTANCE.** Pedestrian push button and pedestrian push button station shall be accepted upon the manufacturer's certification of compliance with these specification requirements. Acceptance of material may require supplementary sampling and testing at the discretion of the Materials Bureau.

#### **724-99 FOR SITE MANAGER USE**

### **SECTION 725 - MISCELLANEOUS METALS AND PLASTICS**

#### **725-01 COPPER FLASHING**

**SCOPE.** This specification covers the material requirements for copper flashing.

**MATERIAL REQUIREMENTS.** Sheet copper for flashing shall be rolled from copper fulfilling the requirements of ASTM B5. This sheet metal shall be cold rolled soft copper.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's certification that the material meets the specification requirements.

#### **725-02 STEPS FOR MANHOLES**

**SCOPE.** This specification covers the material requirements for steps used in manholes.

**GENERAL.** The minimum design live load, for steps, appurtenances and fastenings, shall be a single concentrated load of 800 pounds. The live loads imposed by persons occupying the steps shall be considered to be concentrated at such points as will cause the maximum stress in the structural member being considered.

Steps shall be designed so a worker's foot cannot slide off the end. The minimum length of the rungs shall be 10 inches.

Whenever a combination of dissimilar types of metals are used in the manufacture of steps, appurtenances and fastenings, the materials shall be treated to prevent deleterious effects.

**MATERIALS.** Manhole steps shall be fabricated from one of the following:

**Ferrous Metal.** Steps shall conform to one of the following requirements:

Iron Castings	Class 25A, 715-05
Malleable Iron Castings	Grade 35018, 715-09
Steel	ASTM A575, Grade M 1020 galvanized in accordance with ' 719-01, Type 1.

The steps shall have a minimum cross sectional dimension of 1 inch exclusive of any coatings placed on them.

**Non-Ferrous Metal.** Steps shall conform to the following requirements:

Aluminum Castings Alloy 356-T6, 715-03.  
Wrought Aluminum 6061-T6, 6005-T5, or 6351-T6, 715-04

When aluminum steps are used, the portion of the step which will be in direct contact with cement concrete or concrete mortar, shall be coated with a zinc chromate primer or bituminous material approved by the Materials Bureau.

**Reinforced Plastic.** Steps shall consist of polypropylene or other plastic material completely covering a steel core. The plastic may be extruded, cast, or molded into the standard size and shape manhole steps, and provide corrosion protection.

The plastic material shall have the following characteristics:

**A. Resistance to Salt and Caustic Solutions.** Resistance to the following solutions when submerged for 30 days:

- 10% Sodium Chloride
- 10% Hydrochloric Acid
- 10% Sodium Hydroxide
- 10% Sulfuric Acid

**B. Flow Point.** A flow point of 320°F or greater.

**C. Flexibility.** It shall remain flexible over a temperature range of -22°F to +248°F upon long aging.

**D. Fire Resistance.** It shall be non-burning, self-extinguishing, or very slow burning.

The steel core shall be not less than 1/2 inch diameter and shall have the following physical characteristics:

- Tensile Yield, Minimum 40,000 psi
- Tensile Strength, Minimum 70,000 psi

The plastic step, when cast into a concrete block the proper depth, shall withstand a minimum load of 800 pounds applied on 1 square inch area in the center of the step without cracking or breaking the plastic coating, loosening the step in the concrete or permanently deforming the step.

**BASIS OF ACCEPTANCE.** Manhole steps shall be accepted on the basis of the manufacturer's certification of compliance with this specification. However, the Department reserves the right to take random samples at any time for testing for compliance with the requirements of this specification.

## 725-99 FOR SITE MANAGER USE

## SECTION 726 - DETECTABLE WARNING UNITS

### 726-01 SURFACE-APPLIED DETECTABLE WARNING UNITS

**SCOPE.** This specification covers the material and quality requirements for surface-applied detectable warning units.

**MATERIAL REQUIREMENTS.** Surface-applied detectable warning units shall conform to the dimensions shown on the current standard sheet for detectable warnings.

Units shall be composed of cementitious materials, steel, iron, plastics, polymeric materials, resins, pigments, or as approved by the Director, Materials Bureau. The units shall be an approximate visual

match to the color specified in the Contract Documents. Units shall provide the required contrast (light-on-dark or dark-on-light) with the adjacent curb ramp or other applicable walkway. The units shall be uniform in color and texture, be free of cracks or other defects, and have clean-cut and well-defined edges.

Units shall adhere to hot mix asphalt (HMA) or Portland cement concrete (PCC) surfaces at a minimum air temperature of 60°F, and a minimum surface substrate temperature of 70°F. They shall be weather resistant and durable to normal pedestrian wear and maintenance activities, and show no appreciable fading, lifting, or shrinkage. The units shall be capable of molding or fitting itself to the contours, breaks, and faults of HMA or PCC surfaces, and show no significant tearing, rollback, lifting, or other signs of poor adhesion. The units shall have friction characteristics similar to a broomed PCC surface.

The detectable warning units shall meet the following physical properties:

Standard	Property	Results
ASTM C501	Wear Resistance	Wear Index: >15
ASTM C1028	Slip Resistance	Dry Coefficient of friction 0.8 minimum
ASTM E96	Water Vapor Transmission	10 grams/square foot/24 hours
Various	Adhesion/Bonding Strength	See Note*

\*Note: Due to the various types of materials available, the Manufacturer shall certify, through independent laboratory testing, that the type of material used for detectable warnings will bond to a prepared surface.

**PACKAGING AND SHIPMENT.** Preformed, surface-applied, detectable warning units shall be shipped and packaged in accordance with commercially accepted standards. The following information shall be marked on each package or on the shipping invoice: the name of the product, the name and address of the manufacturer, and the quantity of material.

**BASIS OF ACCEPTANCE.** Acceptance of this material for placement on the Approved List will be based on the manufacturer’s certification of compliance with these requirements and in accordance with procedural directives of the Materials Bureau. Contract acceptance will be based on the manufacturer’s name appearing on the Department’s Approved List.

**726-02 EMBEDDED DETECTABLE WARNING UNITS**

**SCOPE.** This specification covers the material and quality requirements for embedded detectable warning units.

**MATERIAL REQUIREMENTS.** Embedded detectable warning units shall conform to the dimensions shown on the current standard sheet for detectable warnings.

Units shall be composed of cementitious materials, steel, iron, clay, shale, plastics, polymeric materials, resins, pigments, or as approved by the Director, Materials Bureau. The units shall be an approximate visual match to the color specified in the Contract Documents. Units shall provide the required contrast (light-on-dark or dark-on-light) with the adjacent curb ramp or other applicable walkway. The units shall be uniform in color and texture, be free of cracks or other defects, and have clean-cut and well-defined edges.

Where applicable, the units shall adhere to hot mix asphalt (HMA) or Portland cement concrete (PCC) surfaces at a minimum air temperature of 60°F, and a minimum surface substrate temperature of 70°F. They shall be weather resistant and durable to normal pedestrian wear and maintenance activities, and show no appreciable fading, lifting, or shrinkage. The units shall have friction characteristics similar to a broomed PCC surface.

The detectable warning units shall meet the following physical properties:

Property	Results
Compressive Strength, Min., 28 days	8000 psi Minimum
Freeze-thaw Loss (25 Cycles, one per day, 10% NaCl solution) in accordance with NY Test Method 502-3P	1.0 % Maximum

**PACKAGING AND SHIPMENT.** Embedded detectable warning units shall be shipped and packaged in accordance with commercially accepted standards. The following information shall be marked on each package or on the shipping invoice: the name of the product, the name and address of the manufacturer, and the quantity of material.

**BASIS OF ACCEPTANCE.** Acceptance of this material for placement on the Approved List will be based on the manufacturer’s certification of compliance with these requirements and in accordance with procedural directives of the Materials Bureau. Contract acceptance will be based on the manufacturer’s name appearing on the Department’s Approved List.

## SECTION 727 - PAVEMENT MARKING MATERIALS

(Last Revised September, 2016)

### 727-01 EXTRUDED THERMOPLASTIC

**SCOPE.** This specification covers the material requirements for thermoplastic that is extruded, in a molten state, onto a pavement surface. Following a surface application of reflective beads the resultant marking is a reflectorized stripe.

**MATERIAL REQUIREMENTS.** Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of 73°F +/- 3°F.

#### General.

- Formulated for application at temperatures greater than 400°F.
- Show no significant breakdown or deterioration at 475°F.
- Pigment, beads and filler uniformly dispersed in the binder resin.
- Be free from all skins, dirt and foreign objects.
- Comply with the following requirements:

TABLE 727-01-1 THERMOPLASTIC PROPERTIES		
Component	% by Weight	
	White	Yellow
Binder	17.0 min	17.0 min.
Titanium Dioxide	10.0 min	---
Reflective Beads	30-40	30-40
Calcium Carbonate & Inert Fillers	43.0 max	*
Yellow Pigments	---	*

\* Amount and type of yellow pigment, calcium carbonate and inert fillers at the option of the manufacturer, providing the other composition requirements are met and the yellow pigment is lead chromate free.

**Physical Properties.**

**A. Color.** (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0.

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14.

**B. Yellowness Index.** (ASTM D1925 at 2° Observer angle and C Illuminate)

White thermoplastic: 0.12 maximum

**C. Softening Point.** (ASTM E28) Softening point: 194°F minimum.

**D. Specific Gravity.** Between 1.8 and 2.2 as determined by a water displacement method at 77°F.

**E. Field Drying Time.** At 70°F, and thickness between 1/8 inch and 3/16 inch: Completely solid and showing no damaging effect from traffic after 10 minutes.

**Thermoplastic Primer.**

- Specifically designed to enhance the bond of thermoplastic pavement markings to HMA and/or PCC pavements.
- Be either a one-component or two-component, cold- or hot-applied material of the type recommended by the manufacturer.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA, and the NYSDEC.

**PACKAGING AND SHIPPING.** Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Expiration Date
- Quantity
- Two-component primer containers clearly identified as "Part A" and "Part B"
- Primers accompanied with written instructions for use

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product and applicable glass beads in accordance with §727-05 *Glass Beads For Pavement Markings*, independent lab test results in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and a certification that the product conforms to this specification.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Extruded Thermoplastic will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

**727-02 REMOVABLE RAISED PAVEMENT MARKERS**

**SCOPE.** This specification covers the material requirements for removable raised pavement markers for use as interim and temporary pavement markings.

**MATERIAL REQUIREMENTS**

**General.** Removable raised pavement markers shall be:

Designed as single units consisting of an acrylic plastic or another type of durable casing, containing one or two reflective faces.

Approximately square in shape.

Capable of providing daytime delineation.

Adhere to HMA or PCC surfaces using adhesives and/or methods recommended by the manufacturer.

Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting.

Free from dirt or any other contaminants.

**Physical Properties.**

**A. Color.** (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14

**B. Size.**

1. Casing. Minimum: 4 x 4 x 3/4 inch.

2. Reflective Lens. Minimum area of the reflective lens: 0.38 square inches.

**C. Reflectance.** Initial average reflectance values, when measured with incident light parallel to the base of the marker, at an observation angle of 0.2°.

<b>TABLE 727-02-1 REFLECTIVE MARKER LENSES REFLECTANCE</b>				
Color	White		Yellow	
Entrance Angle	0°	20°	0°	20°
Specific Intensity (cd/fc)	1.0	0.4	0.6	0.24

**NOTES:**

1. Observation Angle: The angle at the reflector between the observer's line of sight and the direction of light incident on the reflector.

2. Entrance Angle: The angle in the horizontal plane between the direction of incident light and the normal to the leading edge of reflective marker.

3. Specific Intensity: The luminous intensity (candelas) of returned light at the chosen observation and entrance angles for each footcandle of illumination at the reflector on a plane perpendicular to the incident light.

4. Photometric Test Procedure: The reflective marker to be tested shall be located with the center of the reflective lens at a distance of 5 feet from a uniformly bright light source, having an effective diameter of 0.2 in. The return of light shall be measured using an annular ring photocell

(3/8 inch I.D. x 1/2 inch O.D.). The photocell shall be shielded to eliminate stray light. The distance from the light source center to the photocell center shall be 0.21 inches. If a test distance of other than 5 feet is used, the source and receiver shall be modified in the same proportion as the test distance.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Removable Raised Pavement Markers for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Raised Pavement Markers used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

### **727-03 EPOXY PAINT**

**SCOPE.** This specification covers the material requirements for epoxy pavement marking paint that is applied onto pavement, followed by a surface application of retroreflective beads for use as interim and permanent pavement markings.

### **MATERIAL REQUIREMENTS**

**General.** Epoxy paint shall be:

- Formulated for use as a pavement marking material and for hot-spray application at elevated temperatures.
- Two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g., two volumes of Part A to one volume of Part B).
- VOC compliant and lead chromate free.
- Use organic yellow pigments, Color Index Pigment Yellow 65 (C.I. 11740) and/or 74 (C.I. 11741).
- Have a consistent target value of epoxy in Part A, based on ASTM D1652. Tested on a pigment free basis and calculated as the weight per epoxy equivalent (WPE).
- Have a consistent total amine value of Part B based on ASTM D2074, or an alternate test method for determining the amine value specified by the manufacturer subject to the approval of the Director, Materials Bureau.
- Display no bleeding on the surface upon which the paint is applied.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

### **Physical Properties.**

<i>A. % Pigment - Part A.</i> (ASTM D2371)	Yellow: 23% minimum White: 18% minimum
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% TiO<sub>2</sub> (100% Purity) (NYS Test Method 727-20C) White: 16.5% minimum

**B. % Resin – Part A.** (ASTM D2371) Yellow: 70% - 77%  
White: 75% - 82%

**C. Color.** (ASTM D1535) When viewed under North Standard Daylight, at a 15 ± 1 mil wet film thickness with no glass beads applied:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14 and within the following chromaticity coordinate limits when tested under ASTM E1347.

TABLE 727-03-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.526	0.504	0.468
y	0.426	0.472	0.481	0.450

**D. Directional Reflectance.** (ASTM E1347) White: 84% minimum  
Yellow: 54% minimum

**E. Yellowness Index.** (ASTM D1925 at 2° Observer angle and C Illuminate)  
White Epoxy Paint: 0.12 maximum

**F. Drying Time – Laboratory.** (ASTM D711) Dry to no-pick-up time in 30 minutes maximum at an application rate of 15 ± 1 mils wet-film thickness and glass-sphere application rate of 20 lb/gal.

**G. Hardness.** (ASTM D2240) Samples cured for 72 to 96 hours prior to testing.  
Shore D Hardness: 75 - 100.

**H. Infrared Spectrophotometer Analysis.** (ASTM D2621) The spectrum of each component will be analyzed and maintained as a base record. Any subsequent samples taken from a Department contract must be a reasonable match to the original formulation spectrum accepted by the Materials Bureau for the Approved List.

**Placement Properties.** The material shall be capable of being placed using standard epoxy pavement marking equipment and have a maximum field no track time of 30 minutes when installed at 77°F.

**PACKAGING AND SHIPPING.** Shipped to the job site in strong, substantial containers, clearly marked with the following information:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Date of Manufacture
- Expiration Date
- The Statement (as appropriate):  
“Part A Contains Pigment and Epoxy Resin,” or “Part B Contains Catalyst”
- Quantity

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by two 1/2 pint samples of each color (white and yellow) of Part A and one 1/2 pint of Part B for each color, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Epoxy Paint for Permanent and/or Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Epoxy Paint used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

#### **727-04 PERMANENT PAVEMENT TAPE**

**SCOPE.** This specification covers the material requirements for preformed pavement marking tape that is applied to the pavement for use as permanent pavement markings.

**GENERAL.** Permanent pavement tape shall be:

- Designed to provide immediate and continuous retroreflection.
- Meet all the requirements of ASTM D4505.
- Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.
- Have a layer of reflective beads bonded to, or embedded in the top surface.
- Pre-coated, on its bottom side, with a pressure-sensitive adhesive for adherence to HMA or PCC surfaces.
- Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.
- Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.
- Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.
- Show no significant tearing, rollback, lifting or other signs of poor adhesion.
- Free from dirt and any other contaminants.

**MATERIAL REQUIREMENTS.** Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of  $73^{\circ} \pm 3^{\circ}\text{F}$ .

**A. Color.** (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR8/14

**B. Thickness.** Preformed pavement marking tape shall be:

-Uniform Cross Section: 60 mils minimum thickness.

-Patterned (Variable Cross Section): 20 mils minimum thickness at the thinnest portions and 60 mils minimum thickness at the thickest portions.

-The patterned top surface shall have approximately 50% of the surface area raised, and its design shall provide immediate and continuing retroreflection.

**C. Tensile Strength.** (ASTM D638) 40 psi minimum

Test specimens shall be Type II prepared by die cutting with Die C as specified in ASTM D412 Test Method A. The testing machine shall operate at a speed of 0.2 inches per minute. For calculating the tensile strength of patterned type material, the thickness measurements shall be taken in the thinnest portions of the cross sectional area.

**D. Elongation.** (ASTM D638) When tested in accordance with the conditions as specified for Tensile Strength: 15% minimum elongation

**Primer.** Primer shall be recommended by the manufacturer of the permanent tape and be compatible with the marking and surface the marking is being applied to.

Specifically designed to enhance the bond of the permanent tape to HMA and/or PCC pavements. Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

**PACKAGING AND SHIPPING.** Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity
- Primers accompanied with written instructions for use
- Expiration Date

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Permanent Pavement Tape and primer will be accepted on the basis of the products appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Permanent Pavement Tape and primer used for Temporary Pavement Markings will be accepted on the basis of the products appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **727-05 GLASS BEADS FOR PAVEMENT MARKINGS**

**SCOPE.** This specification covers the material requirements for retroreflective beads applied on top of thermoplastic, epoxy or traffic paint for use as pavement markings.

**MATERIAL REQUIREMENTS.** Glass beads for pavement markings shall meet the requirements of AASHTO M247 and shall be:

- Composed of glass that is highly resistant to traffic wear and to the effects of weathering.
- Colorless, clean, transparent, free from milkiness or excessive air bubbles, and essentially free from surface scarring or scratching.
- Silica content (ASTM C169): 60% minimum.
- Refractive index: 1.50 when tested by the liquid immersion method at 77°F.
- Show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps.
- Flow freely from the dispensing equipment at any time when surface and atmospheric conditions are satisfactory for painting.

**A. Sphericity.** (ASTM D1155 Procedure A) Spherical in shape - 70% minimum, true spheres. Wet/Night Visibility Beads will be tested for roundness according to the procedural directives of the Materials Bureau.

**B. Gradation.** (ASTM D1214).

<b>TABLE 727-05-1 GLASS SPHERE GRADATION (Standard Bead)</b>				
<b>Percent Passing by Weight</b>				
<b>Marking Type</b>	<b>Sieve Size</b>			
	<b>#20</b>	<b>#30</b>	<b>#50</b>	<b>#80</b>
Epoxy	100	80-95	9-42	0-10
Traffic Paint	100	80-95	9-42	0-10
Thermoplastic	100	79-95	15-60	0-15

<b>TABLE 727-05-2 GLASS SPHERE GRADATION (Wet/Night Visibility Bead)</b>						
<b>Percent Passing by Weight</b>						
<b>Marking Type</b>	<b>Sieve Size</b>					
	<b>#10</b>	<b>#12</b>	<b>#14</b>	<b>#16</b>	<b>#18</b>	<b>#20</b>
Epoxy Wet/Night Reflective	100	95-100	75-95	10-47	0-7	0-2

**C. Coating.**

<b>TABLE 727-05-3 GLASS SPHERE COATINGS</b>	
<b>Marking Type</b>	<b>Coating Type</b>
Epoxy Wet/Night Reflective	Silane Type adherence coating designed to interact with and adhere to epoxy pavement markings.
Epoxy (Standard Bead)	Moisture-resistant coating or a dual purpose type coating (moisture-resistant and adherence).
Traffic Paint	
Thermoplastic (Drop on)	

**D. Moisture Resistance.** AASHTO M 247 Section 5.3.2

**PACKAGING AND SHIPPING.** Shipped to the job site in waterproof plastic lined burlap or plastic lined paper bags with the following information clearly marked on the packages:

- Manufacturer's Name
- Name of Product
- Size/Type/Coating
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity/Weight of Material

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by one 50 lb bag sample of the product, independent lab test results in accordance with this specification and certification that the product conforms to this specification.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Glass Beads for Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Glass Beads for Pavement Markings used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **727-06 REMOVABLE PAVEMENT TAPE**

**SCOPE.** This specification covers the material requirements for removable pavement marking tape and masking tape for use as interim and temporary pavement markings.

### **MATERIAL REQUIREMENTS.**

**General.** Removable pavement tape shall be:

- Composed of a mixture of plastics or polymeric materials, resins, pigments.
- Have on its bottom side, a pre-applied, pressure-sensitive adhesive for adherence to HMA or PCC surfaces.
- Of the specified dimension and shape with clean-cut, well defined-edges, of good appearance, and free of cracks or other defects.
- Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.
- Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.
- Show no significant tearing, rollback, lifting or other signs of poor adhesion.
- Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting, and leaving minimal permanent marks, scars or damage to the pavement surface after removal.
- Be free from dirt and any other contaminants.

### **Retroreflective Tape.**

- Designed to provide immediate and continuous retroreflection.

- Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.
- Have a layer of reflective beads bonded to, or embedded in the top surface.

Meet the following requirements:

**A. Color:** (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following chromaticity coordinate limits when tested under ASTM E1347.

TABLE 727-06-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.526	0.504	0.468
y	0.426	0.472	0.481	0.450

**B. Reflectance:**

TABLE 727-06-2 PREFORMED TAPE REFLECTANCE REQUIREMENTS				
Color	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°
Specific Luminance (mcd/ft <sup>2</sup> /fc)	1770	1270	1310	810

**Masking Tape.** Masking tape shall be:

- Specifically designed for use to temporarily cover existing pavement markings.
- Consist of durable, nonreflective, pliant polymer tape on a reinforced, conformable backing, pre-coated with a pressure-sensitive adhesive
- Capable of adhering to existing pavement markings, asphalt pavement and Portland cement concrete pavement without the use of heat, solvents, additional adhesives or other means.
- Be substantially similar in color to the pavement surface with a flat matte finish and textured, skid resistant surface.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white, yellow, black/grey) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Removable Pavement Tape used for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Pavement Tape used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing material on the Approved List and that it conforms to this specification.

## 727-07 REMOVABLE WET-NIGHT REFLECTIVE TAPE

**SCOPE.** This specification covers the material requirements for removable wet-night reflective tape for use as interim and temporary pavement markings.

### MATERIAL REQUIREMENTS.

**General.** Removable Wet-Night reflective tape shall be:

- Designed to provide immediate and continuous retroreflection in day and night as well as dry and wet conditions.
- Composed of a mixture of durable plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.
- Pre-coated, on its bottom side, with a pressure-sensitive adhesive.
- Capable of adhering to existing pavement markings, asphalt pavement and Portland cement concrete pavement without the use of heat, solvents, additional adhesives or other means.
- Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.
- Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.
- Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.
- Show no significant tearing, rollback, lifting or other signs of poor adhesion.
- Removable from HMA and PCC pavements, intact or in substantially large pieces, without the use of heat, solvents, grinding or blasting, and leaving minimal permanent marks, scars or damage to the pavement surface after removal.
- Have a layer of reflective beads bonded to, or embedded in the top surface.
- Free from dirt and any other contaminants.

Meet the following requirements:

### Physical Properties.

**A. Color:** (ASTM D1535) When viewed under North Standard Daylight:

White: Approximate visual color match to Munsell Book Notation N 9.5/0 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

Coordinate	1	2	3	4
x	0.355	0.305	0.285	0.335
y	0.355	0.305	0.325	0.375

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

Coordinate	1	2	3	4
x	0.560	0.460	0.420	0.490
y	0.440	0.400	0.440	0.510

**B. Retroreflectivity.** Wet: ASTM E2176 and ASTM E2177

Dry: ASTM E1710

<b>TABLE 727-07-3 MINIMUM INITIAL RETROREFLECTIVITY</b>				
<b>Entrance Angle: 88.76° Observation Angle: 1.05°</b>				
Color	White		Yellow	
Condition	Dry	Wet	Dry	Wet
Retroreflectivity [mcd/ft <sup>2</sup> /fc]	500	250	300	200

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Removable Wet-Night Reflective Tape used for Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Removable Wet-Night Reflective Tape used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

#### **727-08 PERMANENT WET-NIGHT REFLECTIVE TAPE**

**SCOPE.** This specification covers the material requirements for permanent wet-night pavement marking tape for use as permanent pavement markings.

**MATERIAL REQUIREMENTS.** Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of  $73^{\circ} \pm 3^{\circ}\text{F}$ .

**General.** Permanent wet-night reflective tape shall be:

- Designed to provide immediate and continuous retroreflection in day and night as well as dry and wet conditions.
- Composed of a mixture of plastics or polymeric materials, resins, pigments, and reflective beads that are uniformly distributed throughout the thickness of the material.
- Have a layer of reflective beads bonded to, or embedded in the top surface.
- Pre-coated, on its bottom side, with a pressure-sensitive adhesive for adherence to HMA or PCC surfaces.
- Of the specified dimension and shape with clean-cut, well-defined edges, of good appearance, and free of cracks or other defects.
- Weather resistant and through normal traffic wear shall show no appreciable fading, lifting or shrinkage.
- Capable of molding itself to the contours, breaks and faults of HMA or PCC surfaces.
- Show no significant tearing, rollback, lifting or other signs of poor adhesion.
- Free from dirt and any other contaminants.



**Physical Properties.**

**A. Color:** (ASTM D1535) When viewed under North Standard Daylight:  
White: Approximate visual color match to Munsell Book Notation N 9.5/0 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

<b>TABLE 727-08-1 WHITE CHROMATICITY COORDINATES</b>				
Coordinate	1	2	3	4
x	0.355	0.305	0.285	0.335
y	0.355	0.305	0.325	0.375

Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and be within the following daytime chromaticity coordinates (dry) when tested under ASTM E1347.

<b>TABLE 727-08-2 YELLOW CHROMATICITY COORDINATES</b>				
Coordinate	1	2	3	4
x	0.560	0.460	0.420	0.490
y	0.440	0.400	0.440	0.510

**B. Retroreflectivity.** Wet: ASTM E2176 and ASTM E2177  
Dry: ASTM E1710

<b>TABLE 727-08-3 MINIMUM INITIAL RETROREFLECTIVITY</b>		
<b>Entrance Angle: 88.76° Observation Angle: 1.05°</b>		
Color	White	Yellow
Retroreflectivity (mcd/ft <sup>2</sup> /cd)	750	450

**C. Thickness.**

- Uniform Cross Section: 60 mils minimum thickness
- Patterned (Variable Cross Section): 20 mils minimum thickness at the thinnest portions and 60 mils minimum thickness at the thickest portions.
- The patterned top surface shall have approximately 50% of the surface area raised, and its design shall provide immediate and continuing retroreflection.

**D. Friction Resistance.** (ASTM E303) Friction resistance: 45 BPN minimum.

**E. Tensile Strength.** (ASTM D638) Tensile strength: 40 psi minimum  
Test specimens shall be Type MII prepared by die cutting with Die C as specified in ASTM D412, Test Method A. The testing machine shall operate at a speed of 0.2 inches per minute. For calculating the tensile strength of patterned type material, the thickness measurements shall be taken in the thinnest portions of the cross sectional area.

**F. Elongation.** (ASTM D638) 15% minimum elongation when tested in accordance with the conditions as specified for Tensile Strength.

**Primer.** Primer shall be:

- Be recommended by the manufacturer of the preformed pavement marking and be compatible with the marking and surface the marking is being applied to.
- Specifically designed to enhance the bond of the preformed pavement markings to HMA and/or PCC pavements.
- Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA and the NYSDEC.

**PACKAGING AND SHIPPING.** Shipped to the job site in strong, substantial containers, clearly marked with the following and including:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Manufacture Date
- Quantity
- Primers accompanied with written instructions for use
- Expiration Date

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Additional laboratory analysis and field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Permanent Wet Night Reflective Tape and primer will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Permanent Wet-Night Reflective Tape and primer used for Temporary Pavement Markings will be accepted on the basis of the product appearing on the Approved List. Upon request, the Contractor shall provide a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **727-09 TRAFFIC PAINT**

**SCOPE.** This specification covers the material requirements for waterborne and solventborne paints that are applied onto pavement, followed by a surface application of retroreflective beads for use as temporary, interim and permanent pavement markings.

### **MATERIAL REQUIREMENTS.**

**General.** Traffic paint shall be:

- Formulated for use as a pavement marking material.
- Be VOC compliant and lead chromate free.
- Yellow paints must use organic yellow pigments Color Index Pigment Yellow 65 (C.I. 11740) and/or 74 (C.I. 11741).
- Display no bleeding on the surface upon which the paint is applied.

-Conform to current Federal, State and Local air pollution regulations, including those for the control (emission) of volatile organic compounds (VOC) as established by the U.S. EPA, and the NYSDEC.

**Physical Properties.**

Traffic paint for permanent and Interim Pavement Markings shall conform to the requirements of paragraphs A through L below. Traffic paint for Temporary Pavement Markings shall conform to the following paragraphs: B. *Color*; C. *Directional Reflectance*; D. *Yellowness Index*; E. *Drying Time*; F. *Viscosity*; and G. *Dry Opacity*.

**A. Composition.**

- % Pigment. (ASTM D3723) 58.0% – 62.0%
- % Total Solids. (ASTM D3723) 76.0 % minimum
- % Vehicle Non-Volatile. (ASTM D3723) 43.0 % minimum

The manufacturers certified organic yellow pigment content shall be used to determine the final laboratory test results for: total pigment (%), and for nonvolatile vehicle (%). The Department reserves the right to validate the manufacturers "certified" organic yellow pigment content through outside, independent laboratory testing.

**B. Color.** (ASTM D1535) When viewed under North Standard Daylight at a 15 ± 1 mils wet film thickness with no glass beads applied:

- White: Approximate visual color match to Munsell Book Notation N 9.5/0.
- Yellow: Approximate visual color match to Munsell Book Notation 10YR 8/14 and within the following chromaticity coordinate limits when tested under ASTM E1347.

TABLE 727-09-1 CHROMATICITY COORDINATES				
Coordinate	1	2	3	4
x	0.485	0.517	0.492	0.468
y	0.426	0.462	0.471	0.450

**C. Directional Reflectance** (ASTM E1347) White: 84% minimum  
Yellow: 54% minimum

**D. Yellowness Index.** (ASTM D1925 at 2°Observer angle and C Illuminate)  
White Traffic Paint: 0.12 maximum.

**E. Viscosity.** (ASTM D562 Procedures B) 75 – 95 Kreb Units at 77°F

**F. Dry Opacity.** (ASTM D2805) 0.95 minimum contrast ratio  
Application at 3 1/2 inches wide, wet-film thickness of 5 mils to white and black contrast panels matching Lenta Form 5C or equivalent. Dry time of 1 hour minimum.

**G. Abrasion Resistance.** (ASTM D4060) Four plate samples for each lot will be prepared for testing on the Taber Abaser. The paint will be sprayed on steel plates, or applied by other suitable means so as to ensure a nominal 15 mil wet film thickness on each plate. Plates will be cured at standard laboratory temperature and humidity for 2 to 24 hours. The paint abrasion plates will be cleaned, dressed, and baked at 221°F for 18 hours. After baking, the plates will be allowed to cool in a desiccator for one hour and then weighed. The plates will be abraded for 1000 cycles on the Taber Abraser. The Taber Abraser will be operated with 1.10 lb weights and CS 10 wheels on the machine. After abrading, the samples will be cleaned with a soft brush, placed in a desiccator for one hour and weighed again. The average weight loss for the four plates shall not exceed 0.00176 oz.

**H. Flexibility.** (Federal Specification TT-P-1952B Section 4.5.4) No cracking or flaking visible. Determine flexibility in accordance with Method B of ASTM D522.

**I. Freeze-Thaw Stability.** (Federal Specification TT-P-1952b, Section 4.5.7) No coagulation or change in consistency (ASTM D562) greater than 15 Kreb Units.

**J. Heat Stability.** (Federal Specification TT-P-1952b, Section 4.5.8) Waterborne only. No coagulation, discoloration or change in consistency (ASTM D562) greater than 15 Kreb Units when tested in an oven at  $120^{\circ} \pm 2^{\circ}\text{F}$ .

**K. Infrared Spectrophotometer Analysis.**

Waterborne: (ASTM D3168) Solventborne: (ASTM D2621)

The spectrum of the paint will be analyzed and maintained as a base record. Any subsequent samples taken from a Department contract must be a reasonable match to the original formulation spectrum accepted by the Materials Bureau for the Approved List.

**Placement Properties.**

The material shall be placed using standard traffic paint application equipment and have a maximum field no track time of 3 minutes when installed at  $77^{\circ}\text{F}$ .

**PACKAGING AND SHIPPING.** Shipped to the job site in strong, substantial containers. Individual containers plainly marked with the following information:

- Manufacturer's Name
- Name of Product
- Material Specification Number
- Lot/Batch Number
- Test Number
- Manufacture Date
- Expiration Date
- Quantity

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by eight 1 pint samples of each color (white and yellow) of the product, independent lab test results in accordance with this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Addition field tests will be carried out in accordance with Materials Bureau Directives.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Traffic Paint for permanent and Interim Pavement Markings will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

Traffic Paint used for Temporary Pavement Markings need not appear on the Approved List. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

**727-99 FOR SITE MANAGER USE**

**SECTION 728 - COMPRESSIVE LOAD TRANSMITTING DEVICES**

## **728-01 RUBBER IMPREGNATED WOVEN COTTON-POLYESTER FABRIC**

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for rubber impregnated, woven, cotton-polyester fabric.

**MATERIAL REQUIREMENTS.** Rubber impregnated woven cotton-polyester fabric shall be composed of multiple layers of prestressed cotton-polyester duck with a minimum mass of 8 oz/sy, impregnated and bound with high quality rubber compound, containing rot and mildew inhibitors and anti-oxidants. The duck warp count shall be  $50\pm 1$  threads per inch and the filling count shall be  $40\pm 2$  threads per inch. Each thread shall contain 2 yarns. The material shall contain 64 plies per inch. The number of piles in the furnished material shall be such as to produce the specified thickness.

**TEST.** This material shall exhibit a maximum load deflection of 10% at 1000 psi when tested in accordance with MIL-C-882.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of the manufacturer's certification of compliance with these specification requirements.

## **728-02 RUBBER IMPREGNATED RANDOM FIBER PAD**

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for rubber impregnated random fiber pads.

**MATERIAL REQUIREMENTS.** Rubber impregnated random fiber pad shall be composed of a high quality elastomer with a random distribution of non-asbestos fibers.

**BASIS OF ACCEPTANCE.** Rubber impregnated random fiber pad shall be accepted under an Approved List.

## **728-03 PLAIN RUBBER PAD**

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for plain rubber pads.

**MATERIAL REQUIREMENTS.** Plain rubber vertical load transmitting devices shall contain only polychloroprene as the raw elastomer polymer. The physical properties of the cured material shall comply with ASTM D2000 Line Call Out M2BC514A14B34. The rubber pads shall be cast in a mold under pressure and heat, or may be furnished to Department projects if they have been carefully cut from a larger piece of fully molded material. Shape factors of each device, i.e., net load area divided by the area free to bulge, must exceed twelve (12).

**TEST.** One plain rubber pad sample per size shall be submitted by the Engineer to the Materials Bureau for destructive test.

**BASIS OF ACCEPTANCE.** The presence of the appropriate form, validated by the Materials Bureau, shall constitute evidence of acceptability at the job site for plain rubber pads.

## **728-04 SHEET LEAD**

**SCOPE.** This specification covers the material requirements and basis of acceptance for sheet lead.

**MATERIAL REQUIREMENTS.** Sheet lead shall be lead plate of nominal 1/8 inch thickness, meeting the standard specification for Pig Lead, ASTM B29.

**BASIS OF ACCEPTANCE.** This material shall be accepted on the basis of a manufacturer's certification of compliance with this specification.

**728-05 (VACANT)**

**728-06 SHEET GASKET (TREATED BOTH SIDES)**

**SCOPE.** This specification covers the material requirements for sheet gasket, treated both sides with a parting agent to prevent adhesion to working surfaces. This material is used as a bond breaker and sliding surface in bridge construction.

**MATERIAL REQUIREMENTS.** The sheet gasket shall have a nominal 1/16 inch thickness and shall be treated on both sides with a parting agent. The material shall meet the following requirements:

<b>TABLE 728-06-1 SHEET GASKET REQUIREMENTS</b>		
<b>Property</b>	<b>Test Method</b>	<b>Requirement</b>
Water absorption, %	Prepare 3 samples (2x2 inches, 1/16±1/32 inch thick). Record initial weight of the specimen. Immerse the samples in a distilled water tank for 24 hrs at room temperature. Take out the samples and dry it with a dry cloth, then record final weight. Use the difference in weight to calculate the water absorption %.	25.0 Maximum
Coefficient of static friction	ASTM D1894	0.36 Maximum
Coefficient of kinetic friction	ASTM D1894	0.24 Maximum
Tensile strength, psi in the weakest direction	ASTM F152, Type 2	1200 Minimum

**BASIS OF ACCEPTANCE.** Sheet Gaskets will be accepted on the basis of the product appearing on the Department's Approved List.

**728-99 FOR SITE MANAGER USE**

**SECTION 729 - TEMPORARY TRAFFIC CONTROL DEVICES**

(Last Revised January, 2022)

**729-01 DRUMS**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for traffic drums. Drums are defined by FHWA as a Category I device.

**MATERIAL REQUIREMENTS.** Drums shall meet the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be orange plastic, one-piece or two-piece construction, with a closed top. Drums shall be a minimum of 18 inches in diameter (visible from all directions), a minimum of 36 inches in height. Drums shall have a maximum weight of 75 lbs., including ballast. Two-piece drums shall consist

of a base no more than 4 inches in height and an upper section. The base and upper section of two-piece drums shall be designed as a unit. One-piece drums shall include a base ring or elongation designed to hold ballast. The base and/or any nonflexible portion of the drum shall not extend more than 2 inches above the pavement surface.

Drums shall have 4 horizontal circumferential stripes of retro-reflective sheeting a minimum of 6 inches wide, of alternating fluorescent orange and white, starting with fluorescent orange on the top. The fluorescent orange and white retro-reflective material used on a barrel shall be of the same type and brand. The top edge of the upper band shall be a maximum of 2 inches from the top edge of the drum. The space between stripes shall not exceed 3 inches.

**Retro-reflective sheeting.** Retro-reflective sheeting shall be:

- Firmly bonded to the drum with an adhesive; mechanical fasteners will not be allowed.
- Re-boundable and able to resist multiple impacts.

Retro-reflective sheeting shall conform to the following sections of AASHTO M268 for White and Fluorescent Orange:

Daytime Luminance Factor: Table 1 - Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D  
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retro-reflectivity: Table 5 - Minimum Coefficient of Retro-reflection ( $R_A$ ) for Type B Sheeting

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

## 729-02 CONES

**SCOPE.** This specification covers the material, fabrication, and performance requirements for traffic cones. Cones are defined by FHWA as a Category I device.

**MATERIAL REQUIREMENTS.** Cones shall meet the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be orange rubber or plastic. Cones shall have a maximum weight of 20 lbs, including ballast.

Standard cones shall be approximately 28 inches in height with a minimum conical bottom width of 10 inches. Standard cones shall have two horizontal circumferential stripes of white retroreflective sheeting, the upper a minimum of 6 inches wide, with the upper edge 3 to 4 inches from the top of the cone, and the lower a minimum of 4 inches wide with the upper edge approximately 2 inches below the upper stripe.

Tall cones shall be approximately 36 inches in height with a minimum conical bottom width of 10 inches. Tall cones shall have two horizontal circumferential stripes of white retroreflective sheeting, the upper a minimum of 6 inches wide, with the upper edge 3 to 4 inches from the top of the cone, and the lower a minimum of 4 inches wide with the upper edge approximately 2 inches below the upper stripe.

Extra tall cones shall be a minimum of 42 inches in height with a minimum conical bottom width of 7 inches. Extra tall cones shall have a minimum of four horizontal circumferential stripes of retroreflective sheeting from 4 to 6 inches wide, of alternating orange and white starting with orange on the top. The upper edge of the sheeting shall be 4 inches from the top of the cone. Nonreflective spaces between the stripes shall not exceed 3 inches wide.

**Retroreflective sheeting.** Retroreflective sheeting shall be:

- Firmly bonded to the cone with an adhesive; mechanical fasteners will not be allowed.

- Re-boundable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (% Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D  
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

### 729-03 TEMPORARY TUBULAR MARKERS

**SCOPE.** This specification covers the material, fabrication, and performance requirements for tubular markers. Tubular markers are defined by FHWA as a Category I device.

**MATERIAL REQUIREMENTS.** Tubular markers shall meet the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be orange, with a minimum height of 36 inches and a minimum outside diameter of 2 inches. Tubular markers shall be circular, elliptical, or other similar shape in cross section. Tubular markers shall have a maximum weight of 12 lbs, not including a mounting base.

The markers shall have two horizontal circumferential stripes of white retro-reflective sheeting, a minimum of 3 inches wide each. Both stripes of sheeting shall be of the same type and brand. The top edge of the upper band shall be a maximum of 2 inches from the top of the marker. The space between the stripes shall not exceed 6 inches.

For free-standing tubular markers, the base and/or any nonflexible portion of the marker shall not be more than 2 inches in height.

For tubular markers fastened to pavement, the bonding system shall be a fast-setting chemical compound, mastic-type material, or mechanical fastener capable of fixing the tubular marker to either concrete or asphalt pavement. The bonding system shall not present a hazard to traffic if the tubular marker or base unit becomes unfixed from the pavement.

**Retro-reflective sheeting.** Retro-reflective sheeting shall be:

- Firmly bonded to the post with an adhesive; mechanical fasteners will not be allowed.
- Re-boundable and able to resist multiple impacts.

Retro-reflective sheeting shall conform to the following sections of AASHTO M268 for White:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (% Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D  
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retro-reflectivity: Table 5 - Minimum Coefficient of Retro-reflection (R<sub>A</sub>) for Type B Sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

### 729-04 VERTICAL PANELS



**SCOPE.** This specification covers the material, fabrication, and performance requirements for vertical panels. Vertical panels are defined by FHWA as a Category II device.

**MATERIAL REQUIREMENTS.** Vertical panels shall conform to the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be constructed of plastic, aluminum, or other lightweight materials. Vertical panels shall be supported by a base capable of maintaining the panel in an upright position and in the proper position and orientation.

Standard vertical panels shall be a minimum of 24 inches in height and a minimum of 8 inches in width. The top of the panel shall be mounted a maximum of 36 inches high. Support posts for standard vertical panels shall not be located on the traffic face of the panel.

Oversized vertical panels shall be a minimum of 36 inches in height and have a minimum reflective area of 2.0 square feet.

Vertical panels shall have 4 to 6 inch wide, retro-reflective diagonal stripes sloping toward the side on which traffic is to pass, at an angle of 45°, alternating orange and white colors. Vertical panels which are 36 inches and larger shall have 6 inch wide diagonal stripes.

**Retro-reflective sheeting.**

Retro-reflective sheeting shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the panels with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Note: Panels supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

**729-05 STOP/SLOW PADDLES**

**SCOPE.** This specification covers the material requirements for stop/slow paddles.

**MATERIAL REQUIREMENTS.** Stop/slow paddles shall conform to the requirements of the MUTCD and shall be constructed of plastic, aluminum, or other lightweight materials. Stop/slow paddles shall be a minimum of 24 inches wide and shall be mounted on a support staff with a minimum height of 6 feet to the bottom of the panel. Reflective sheeting shall conform to §730-05 *Retro-Reflective Sign Sheeting - NYSDOT Class A*. Characters including letters, numerals, route shields, symbols, logos, and borders shall comply with §645-2.02 *Sign Panels - E. Sheeting Sign Characters*.

Note: Paddles supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification

**729-06 TYPE I CONSTRUCTION BARRICADES**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for Type I construction barricades. Type I construction barricades are defined by FHWA as a Category II device.

**MATERIAL REQUIREMENTS.** Type I construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type I construction barricades shall be constructed of an A frame with a single rail panel 8 to 12 inches wide and a minimum of 24 inches long. Rails on barricades used on expressways and other high-speed roadways shall have a minimum reflective area of 2.0 square feet. The top of the upper panel shall be mounted at a minimum height of 36 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Non-rigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic. Barricade rail panels shall have 4 inch wide, retro-reflective diagonal stripes sloping downward at an angle of 45 degrees in the direction road users are to pass, alternating orange and white colors.

**Retro-reflective sheeting.** Retro-reflective sheeting shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Note: Barricades supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

## **729-07 TYPE II CONSTRUCTION BARRICADES**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for Type II construction barricades. Type II construction barricades are defined by FHWA as a Category II device.

**MATERIAL REQUIREMENTS.** Type II construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type II construction barricades shall be constructed of a frame with two rail panels 8 to 12 inches wide and a minimum of 24 inches long. Rails on barricades used on expressways and other high-speed roadways shall have a minimum reflective area of 2.0 square feet. The top of the upper panel shall be mounted at a minimum height of 36 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Non-rigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic.

Barricade rail panels shall have 4 to 6 inch wide, retro-reflective diagonal stripes sloping downward at an angle of 45 degrees in the direction road users are to pass, alternating orange and white colors. Barricade rail panels 36 inches and longer shall have 6 inch wide stripes.

### **Retro-reflective sheeting.**

Retro-reflective sheeting shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Note: Barricades supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **729-08 TYPE III CONSTRUCTION BARRICADES**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for Type III construction barricades. Type III construction barricades are defined by FHWA as a Category II device.

**MATERIAL REQUIREMENTS.** Type III construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type III construction barricades shall be constructed of a frame with three rail panels 8 to 12 inches wide and a minimum of 48 inches long. The top of the upper panel shall be mounted at a minimum height of 60 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Nonrigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic.

Barricade rail panels shall have 6 inch wide retro-reflective diagonal stripes, sloping downward at an angle of 45 degrees in the direction road users are to pass, alternating orange and white colors.

#### **Retro-reflective sheeting.**

Retro-reflective sheeting shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Note: Barricades supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

**Warning Lights.** Warning lights, when used, shall be securely mounted directly to the barricade frame, above the top rail, using a bolt, nut, and washer of sufficient strength to ensure that the light does not detach if impacted by a vehicle, and no part of the light or wiring shall cover the face of the rail. Batteries shall be placed at ground level, except that integral batteries weighing a maximum of 7 lbs may be mounted on the barricade frame. Warning lights shall not be attached to the barricade rail.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **729-09 TEMPORARY SIGN SUPPORTS**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for temporary sign supports. Temporary sign supports are defined by FHWA as a Category II device.

**MATERIAL REQUIREMENTS.** Temporary sign supports shall conform to the requirements of the MUTCD and shall be constructed in accordance with the Standard Sheets or shall be commercially manufactured, temporary sign supports that are NCHRP 350 or MASH approved.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **729-10 TEMPORARY IMPACT ATTENUATORS - REDIRECTIVE**

**SCOPE.** This specification covers the material and performance requirements for temporary impact attenuators. Temporary impact attenuators are defined by FHWA as a Category III device.

**MATERIALS REQUIREMENTS.** Temporary impact attenuators shall be NCHRP 350 or MASH approved as a redirective, non-gating device. Temporary impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Temporary impact attenuators meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. A Temporary impact attenuator accepted as a Test Level 3 device is also acceptable as Test Level 2 device. Temporary impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds. Approach ends of Temporary impact attenuators shall have impact attenuator markings in accordance with the MUTCD.

Concrete Grouting Material	701-05
Anchoring Materials - Chemically Curing	701-07

If a temporary foundation slab is required, concrete shall be Class A concrete conforming to Section 501 *Portland Cement Concrete - General*; reinforcing steel shall conform to §709-01 *Bar Reinforcement, Grade 420*.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have Test Level 2 or Test Level 3 temporary impact attenuators approved shall prepare and submit copies of drawings, specifications, test reports, and Federal acceptance letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Test Level 2 or Test Level 3 temporary impact attenuators will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-11 TEMPORARY IMPACT ATTENUATORS - GATING**

**SCOPE.** This specification covers the material and performance requirements for temporary impact attenuators. Temporary impact attenuators are defined by FHWA as a Category III device.

**MATERIALS REQUIREMENTS.** Temporary impact attenuators shall be NCHRP 350 or MASH approved as a gating device. Temporary impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Temporary impact attenuators meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. A Temporary impact attenuator accepted as a Test Level 3 device is also acceptable as Test Level 2 device. Temporary impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds. Approach ends of Temporary impact attenuators shall have impact attenuator markings in accordance with the MUTCD.

Concrete Grouting Material	701-05
Anchoring Materials - Chemically Curing	701-07

If a temporary foundation slab is required, concrete shall be Class A concrete conforming to Section 501 *Portland Cement Concrete - General*; reinforcing steel shall conform to §709-01 *Bar Reinforcement, Grade 420*.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have Test Level 2 or Test Level 3 temporary impact attenuators approved shall prepare and submit copies of drawings, specifications, test reports, and Federal acceptance letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Test Level 2 or Test Level 3 temporary impact attenuators will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-12 TRUCK-MOUNTED AND TRAILER MOUNTED IMPACT ATTENUATORS**

**SCOPE.** This specification covers the material and performance requirements for truck mounted impact attenuators or trailer mounted impact attenuators (TMIA) mounted on the rear of work vehicles and barrier trailers. Impact attenuators are defined by FHWA as a Category III device.

**MATERIALS REQUIREMENTS.** TMIA shall be NCHRP 350 or MASH approved. TMIA meeting the requirements of NCHRP 350 or MASH Test Level 3 are also acceptable as a Test Level 2 device. TMIA meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. Approach ends of TMIA shall have impact attenuator markings in accordance with the MUTCD.

Trailers shall display retro-reflective markings in compliance with Code of Federal Regulations 49 CFR 393.11- Lamps and Reflective Devices. The markings need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the trailer.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Test Level 2 or Test Level 3 TMIA will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-13 TEMPORARY SAND BARRELS**

**SCOPE.** This specification covers the material and performance requirements for sand barrels. Sand barrels are defined by FHWA as a Category III device.

**MATERIAL REQUIREMENTS.** Sand barrels of each size module shall be NCHRP 350 or MASH approved. Sand barrels shall be yellow, durable, waterproof, ultraviolet-stable plastic. The first barrel in the array shall have impact attenuator markings in accordance with the MUTCD.

Sand barrels shall resist deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion/contraction and fill settlement. Sand barrels shall be free draining with respect to residual moisture in the fill sand. Lids shall divert precipitation and prevent moisture from entering the module. Lids shall be fastened or otherwise secured to provide a closed, reasonably vandal-resistant barrel.

The fill sand shall conform to the requirements of either 703-06 *Cushion Sand* or 703-07 *Concrete Sand*. Sodium chloride, as dry rock salt, equal to 3-5 % by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of 712-03 *Sodium Chloride*.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** Sand barrels will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-14 VEHICLE-ARRESTING SYSTEMS**

**SCOPE.** This specification covers the material and performance requirements for vehicle-arresting systems. Vehicle-arresting systems are defined by FHWA as a Category III device.

**MATERIAL REQUIREMENTS.** Vehicle-arresting systems shall be NCHRP 350 or MASH approved.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days.

**BASIS OF ACCEPTANCE.** Vehicle-arresting systems will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-15 ARROW PANELS**

**SCOPE.** This specification covers the material and performance requirements for arrow panels. Arrow panels are defined by FHWA as a Category IV device.

**MATERIAL REQUIREMENTS.** Arrow panels shall be signs with a matrix of illuminated elements capable of either flashing or sequential arrow displays that meets the requirements of the MUTCD. Arrow panels shall be equipped with a sign control console, mounted in a lockable, weather-resistant compartment.

Arrow panels shall not bear any advertising message or any other message that is not related to traffic control. A non-retro-reflective logo or name and telephone number of the contractor or supplier may be located on the back of the arrow panel or on the arrow panel trailer. The logo shall not exceed 1 ft<sup>2</sup>. The name and telephone number shall not exceed 2 inches in height. The rear face of the arrow panel shall contain one or more clear lamp(s) to indicate that the arrow board is operating properly.

Trailers shall display retro-reflective markings in compliance with Code of Federal Regulations 49 CFR 393.11- Lamps and Reflective Devices. The markings need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the trailer.

**Truck-Mounted Series B.** Arrow panels consist of a 60 x 30 inch rectangular panel mounted at a minimum of 5 feet above the roadway. The arrow display shall be legible at a minimum distance of 3/4 mile on a bright, sunny day or a clear night when the sight line is unobstructed.

**Trailer-Mounted or Truck-Mounted Series C.** Arrow panels consist of a 96 x 48 inch rectangular panel mounted at a minimum of 7 feet above the roadway for trailer mounted arrow panels and 5 feet above

the roadway for truck mounted arrow panels. Arrow panels shall be powered by self-contained engine-driven generator systems, capable of energizing the arrow displays for 72 hours unattended and shall be capable of being powered by 110V AC supply; solar-powered, capable of energizing the arrow displays continuously for 21 days unattended; or powered by a truck. Arrow panel operation controls shall be mounted in a lockable enclosure. The arrow display shall be legible at a minimum distance of 1 mile on a bright, sunny day or a clear night when the sight line is unobstructed.

**TESTING.** Manufacturers or material suppliers desiring to have Truck-Mounted Series B arrow panels or Trailer-Mounted or Truck-Mounted Series C arrow panels considered for inclusion on the Approved List shall submit test results from the AASHTO National Transportation Product Evaluation Program (NTPEP), and a material certification that the arrow panel conforms to this specification and the requirements of the MUTCD.

**BASIS OF APPROVAL.** Truck-Mounted Series B arrow panels and Trailer-Mounted or Truck-Mounted Series C arrow panels meeting the requirements of this specification, as well as satisfactory NTPEP test results, will be placed on the Approved List. Trailer-Mounted or Truck-Mounted Series C arrow panels for which NTPEP test results have not been submitted may be provisionally placed on the Approved List for a maximum of one year. After one year of provisional approval, the manufacturer may request an extension for one additional year based on a pending application filed with NTPEP for testing. No extensions of provisional approvals past two years will be granted. If satisfactory test results are not provided by the expiration date of the provisional approval, all units provided or in use shall be removed and replaced by the Contractor with approved units at no additional cost to the State. Arrow panels on the Approved List that have repeated poor evaluations will be removed from the Approved List.

**BASIS OF ACCEPTANCE.** Arrow panels will be accepted on the basis of the product appearing on the Approved List and a material certification that the product meets this specification and is the same as the one appearing on the Approved List.

## **729-16 PORTABLE VARIABLE MESSAGE SIGNS (PVMS)**

**SCOPE.** This specification covers the physical and performance requirements for Portable Variable-Message Signs (PVMS).

**GENERAL.** PVMS shall be trailer mounted and equipped for use on public highways in accordance with NYS Vehicle and Traffic Law. The trailer shall have 4 leveling jacks capable of leveling the trailer on slopes up to 1 on 6 and capable of stabilizing the trailer in winds up to 75 mph.

PVMS shall operate primarily from a solar powered electrical system that consists of a battery bank, solar array panels, and on-board auxiliary charging system to enable the batteries to be recharged via a 110V AC connection. The solar array panels and battery bank shall supply power sufficient to operate the complete unit, including integrated accessories for a minimum of 21 days without auxiliary charge.

PVMS shall not bear any advertising message or any other message that is not related to traffic control. A non-retro-reflective logo or name and telephone number of the contractor or supplier may be located on the back of the PVMS or on the PVMS trailer. The logo shall not exceed 1 square foot. The name and telephone number shall not exceed 2 inches in height.

Trailers shall display retro-reflective markings in compliance with Code of Federal Regulations (CFR) 49 CFR 393.11- Lamps and Reflective Devices. The markings need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the trailer.

All electrical systems in the PVMS shall be FCC Part 15 compliant and sufficiently shielded to prevent interference with the two-way radio system equipment used by the Department.

PVMS shall be equipped with a sign control console mounted in a lockable, weather-resistant compartment. The sign controller shall have programmable memory capable of storing messages pertinent to planned construction activities, including emergency messages. The controller shall be equipped with 14 day calendar programming capability, providing the ability to start and stop the display of a minimum of 3 different messages on a repeating schedule without an operator present. The controller shall be capable of producing an accurate log of all messages and the times they were displayed. The controller shall have programmable messages, display rate, and display interval settings. The controller shall blank the sign if the output voltage drops below the manufacturer's recommended output level.

PVMS shall be equipped with control software compatible with the Department's current Microsoft Windows operating system. Upon request, the Contractor shall supply the Engineer with two copies of operating instructions for the PVMS and the control software. Electronic copies of software instructions are acceptable.

**DISPLAY.** The color of light emitted shall be amber. PVMS shall be capable of displaying 3 lines of alphanumeric characters, and 3 separate messages in a cyclical sequence. On/Off time for each message in a sequence shall be user adjustable within a range of 0 to 5 seconds, in a minimum of 0.5-second increments.

The PVMS shall be visible at a distance of 1/2 mile during the day and at night. For highways with a posted pre-construction speed limit of 55 MPH or greater, PVMS messages shall be legible from a minimum distance of 800 feet during the day and 600 feet at night. For highways with a posted pre-construction speed limit of 50 MPH or less, PVMS messages shall be legible from a minimum distance of 650 feet. The viewing angle of the PVMS shall be a minimum of 15 degrees to the left and to the right of the sign's midpoint.

PVMS characters shall be at least 7 pixels high, with a minimum width to height character ratio of 70% (ex. 5x7 pixels per character, assuming nearly equal horizontal and vertical pixel pitch). Each pixel shall be formed by clusters of equality spaced Light Emitting Diodes (LED's). The number of LEDs per pixel (typically 3 or 4) shall be determined by the manufacturer in order to produce the required illumination and legibility. The PVMS characters shall comply with the minimum number of characters per line and minimum character heights.

Small size. - Full Matrix PVMS shall be capable of displaying:

- Eight characters per line
- At least 12" high characters per line, when three lines are displayed.

Standard size. - Line /Character or Full Matrix PVMS shall be capable of displaying:

- Eight characters per line
- Up to 18" high characters per line, when three lines are displayed.

Large size. - Full Matrix PVMS shall be capable of displaying:

- A minimum of 10 characters per line
- At least 18" high characters per line, when three lines are displayed.

PVMS messages shall comply with *NYS DOT's Variable Message Sign Guidelines*. PVMS messages shall not display any advertising message or any other message that is not related to traffic control or highway safety.

## **OPTIONAL EQUIPMENT**

**A. Radar.** PVMS equipped with radar shall have the ability to determine the speed of an approaching vehicle and interrupt the programmed sequence with a customized default message displaying the vehicle's speed.



**B. CCTV Camera.** PVMS equipped with a CCTV camera shall be able to monitor traffic and/or weather conditions by recording live streaming video, and capable of taking still images of the vicinity. The camera shall have pan, tilt, and zoom functions. The camera shall have a parapet mounting bracket to allow an elevated mounting height. The camera shall be able to transmit data to a modem on the PVMS via a cellular connection.

**CELLULAR COMMUNICATION.** PVMS shall have provisions for mounting of communication equipment, including cellular antennas and external line cables in accordance with industry standards.

PVMS with cellular communications shall be equipped with a static Internet Protocol (IP) Address in accordance with the NYS Office of Information Technology Service (NYS OITS) requirements and a cellular modem and a cellular service plan capable of remotely operating the control software. This may require coordination and configuration with the Department in order to ensure connectivity between the PVMS and the Regional Transportation Management Center using the sign control software.

**NTCIP COMPLIANT.** NTCIP Compliant PVMS shall be equipped with communication and control systems that are National Transportation Communication for ITS Protocol (NTCIP) compliant.

PVMS shall be equipped with control software compatible with the Department's current operating system. The Contractor shall supply the Engineer with two copies of operating instructions for the PVMS and the control software. Electronic copies of software instructions are acceptable.

**TRAINING.** Upon request, training for Regional Transportation Management Center personnel in the remote operation of the PVMS shall be provided by a qualified Technician or Manufacturer Representative.

**TESTING.** Manufacturers or material suppliers desiring to have PVMS considered for inclusion on the Approved List shall follow the *NYS DOT PVMS Certification Requirements* guidance and submit all necessary documentation to the Director, Materials Bureau in Albany. The Certification Requirements are available on the Materials & Equipment Approved List page of the Department's website: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/materials-and-equipment>.

**BASIS OF APPROVAL.** PVMS meeting the requirements of this specification and the *NYS DOT PVMS Certification Requirements* will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** The PVMS will be accepted on the basis of the product appearing on the Approved List and a material certification that the product meets this specification and is the same as the one appearing on the Approved List. NTCIP compliant PVMS communication functionality will be verified by the Engineer within a maximum 20 work day period from the date of delivery to the work site.

## **729-17 TEMPORARY GLARE SCREENS**

**SCOPE.** This specification covers the material and performance requirements for temporary glare screens. Glare screens are not defined separately by FHWA, but rather are considered a system component.

**MATERIAL REQUIREMENTS.** Temporary glare screens shall consist of an opaque screen on a horizontal base which is, in turn, mounted on a concrete barrier. The system shall be modular to allow flexible use and ease of maintenance.

The screen shall be constructed of durable, lightweight, flexible, weather-resistant, and impact-resistant materials of a single, uniform dark color. The minimum height of the screen shall be approximately 24 inches. The screen shall be reflectorized at a uniform maximum spacing of 40 feet. If barrier delineation is blocked, the screen shall be reflectorized on both sides with a 3 inch wide by 6 inch high (minimum) piece of retro-reflective sheeting.

Retro-reflective sheeting shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the screens with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Yellow reflective sheeting shall be used facing traffic which is to pass to the right of the glare screen. White reflective sheeting shall be used facing traffic which is to pass to the left of the glare screen.

Note: Screens supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type IX retro-reflective sign sheeting.

Individual temporary glare screen modules shall not span a joint between concrete barrier sections, and bases shall not overhang the face of the barrier. Temporary glare screens shall not have any horizontal rigid members that could potentially spear an impacting vehicle, or shall be NCHRP 350 or MASH approved if the system has horizontal rigid members.

The base shall have sufficient rigidity to facilitate ease of handling and proper screen support and position. The connection of the base to the vertical components shall prevent unintentional screen rotation or dislocation. The base shall be properly secured to prevent it from being dislodged upon impact.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **729-18 WARNING LIGHTS**

**SCOPE.** This specification covers the material and performance requirements for warning lights. Warning lights are not defined separately by FHWA, but rather are considered a system component.

**MATERIAL REQUIREMENTS.** Warning lights shall be mounted on signs or channelizing devices in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield. Warning lights shall be Type A (low-intensity flashing), Type B (high-intensity flashing), or Type C (steady-burning). Warning lights shall meet the requirements of the MUTCD Section 6F.83 and the ITE *Purchase Specification for Flashing and Steady Burn Warning Lights*. Warning lights shall have a minimum nominal diameter of 7 inches and shall emit yellow light. Flashing warning lights shall flash between 55 and 75 times per minute. Flashing warning lights required to operate 24 hours per day shall be Type B. Steady-burning warning lights shall operate from one-half hour after sunset to one-half hour before sunrise. Warning lights shall have a minimum mounting height of 30 inches to the bottom of the lens. Warning lights shall be powered by batteries, line power, or solar cells adequate to maintain the required luminance during all periods of required operation.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **729-19 AUTOMATED FLAGGER ASSISTANCE DEVICES**

**SCOPE.** This specification covers the material and performance requirements for automated flagger assistance devices (AFAD) designed to control road users through work zones to be remotely operated by a flagger. AFADs are defined by FHWA as a Category IV device.

**MATERIAL REQUIREMENTS.** AFADs shall meet the requirements of the MUTCD. Each AFAD shall consist of a remotely controlled self-contained trailer or movable cart consisting of *STOP/SLOW* signs or *RED/YELLOW* lenses.

Stop/Slow Sign AFAD shall consist of:

- A STOP/SLOW sign (R1-1/W20-8) having an octagonal shape of at least 36 x 36 inch with letters at least 12 inches high.
  - One red stop beacon, 12 inch diameter red Light Emitting Diode (LED), mounted above the *STOP* sign.
  - At least one amber beacon, 12 inch diameter amber Light Emitting Diode (LED) or Type B high-intensity flashing warning light mounted above, below or to the side(s) of the *SLOW* sign.
- A gate arm capable of extending up to 8.5 feet.
- *WAIT ON STOP* (R1-7) and *GO ON SLOW* (R1-8) signs mounted under the *STOP/SLOW* sign.
  - *WAIT ON STOP* sign shall be a 24 x 30 inches with black legend and black border on a white retro-reflective background, with letters at least 2 inches high.
  - *GO ON SLOW* sign shall be a 24 x 30 inches with black legend and black border on a white retro-reflective background, with letters at least 2 inches high.

RED/Yellow Lens AFAD shall consist of:

- Circular red and circular yellow 12 inch diameter Light Emitting Diode (LED) displays.
- A gate arm capable of extending up to 8.5 feet.
- STOP HERE ON RED sign (R10-6) 24 x 30 inches.

Retro-reflective sheeting used on the sign panels shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and be firmly bonded to the sign panels with an adhesive. Mechanical fasteners will not be allowed. Characters including letters, numerals, route shields, symbols, logos, and borders shall comply with §645-2.02 *Sign Panels - E. Sheeting Sign Characters*.

The AFADs shall be controlled by a single flagger with a remote control, which shall allow safe operation of two AFADs remotely, employ bi-directional communications to verify each command sent from the handheld was successfully received, be equipped with conflict monitoring to prevent displaying a SLOW message simultaneously in both directions, permit an override feature to allow a simultaneous slow display, and show the current status of each AFAD. The control console and power supply shall be housed in a locked compartment. Each trailer/cart shall be equipped with a remote control warning horn alerting workers of intruding vehicles.

Trailers/carts shall display retro-reflective markings in compliance with Code of Federal Regulations 49 CFR 393.11- Lamps and Reflective Devices. The markings need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the trailer.

AFADs shall not bear an advertising message(s) or any other message that is not related to traffic control. A non-retro-reflective logo or name and telephone number of the contractor or supplier not to exceed 1.0 square foot may be located on the trailer or cart. The name and telephone number shall not exceed 2 inches in height.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have AFADs be considered for inclusion on the Approved List shall submit a material certification that the AFADs meet this specification and the requirements of the MUTCD, as well as provide one AFAD for initial field testing to the Director of the Materials Bureau in Albany for review. Initial field testing will include evaluating the AFADs for

operation, sign visibility/legibility, retractable arm functionality/visibility and beacon/warning light brightness and angularity. The review process requires a minimum of 30 calendar days.

AFADs having acceptable certifications and satisfactory initial field test results will be placed on the Approved List. AFADs that consistently have repeated poor evaluations will be removed from the approved list.

**BASIS OF ACCEPTANCE.** AFADs will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

## **729-20 PORTABLE TRAFFIC SIGNALS**

**SCOPE.** This specification covers the material and performance requirements for portable traffic signals. Portable traffic signals are defined by FHWA as a Category IV device.

**MATERIAL REQUIREMENTS.** Portable traffic signals shall meet the requirements of the MUTCD. Portable traffic signals shall consist of two self-contained, trailer-mounted traffic signals, each with a vertical signal mast, horizontal mast arm and two - 3 section traffic signal heads. Each traffic signal head shall have 12 inch diameter circular red, yellow, and green Light Emitting Diode (LED) modules.

The portable traffic signal system shall be able to function continuously and independent of utility power sources. The signal control console and power supply shall be housed in a locked compartment. The traffic signal controller shall be password protected, capable of providing traffic-actuated control with microwave detector sensors, have a built-in conflict monitor to prevent the display of conflicting indications, shall be hard-wired or radio-controlled to keep the signal indications synchronized, and have adequate phasing to serve expected traffic movements.

Trailers shall display retro-reflective markings in compliance with Code of Federal 49 CFR 393.11- Lamps and Reflective Devices. The sheeting need not be continuous, but the sum of the length of the segments shall be at least one-half the length of the trailer.

Portable traffic signals shall not bear an advertising message(s) or any other message that is not related to traffic control. A non-retro-reflective logo or name and telephone number of the contractor or supplier may be located on the portable traffic signal trailer. The logo shall not exceed 1.0 square foot. The name and telephone number shall not exceed 2 inches in height.

**BASIS OF APPROVAL.** Manufacturers or material suppliers desiring to have Portable Traffic Signals considered for inclusion on the Approved List shall submit a material certification that the Portable Traffic Signal meets this specification and the requirements of the MUTCD, as well as one portable traffic signal for initial field testing to the Director of the Materials Bureau in Albany for review. Initial field testing will include evaluating the traffic signal system for phasing, clearances, detector operation and layout of the signal faces for brightness and angularity. The review process requires a minimum of 30 calendar days. Portable traffic signals having acceptable certifications and satisfactory initial field test results will be placed on the Approved List.

Portable traffic signals on the Approved List that consistently have poor evaluations will be removed from the Approved List.

**BASIS OF ACCEPTANCE.** Portable traffic signals will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

### **729-21 TEMPORARY OVERLAY MARKERS**

**SCOPE.** This specification covers the material and performance requirements for temporary overlay markers.

**MATERIAL REQUIREMENTS.** Temporary overlay markers are flexible polymer “L” shaped road reflectors with an adhesive on its base to adhere to the pavement surface. Temporary overlay markers are approximately 4 inches wide by 2 inches high with at least a 1 inch base. Yellow temporary overlay markers have a yellow retro-reflective sheeting strip a minimum of ¼ inch in height at the top of the vertical section on both sides. White temporary overlay markers have a white retro-reflective sheeting strip a minimum of ¼ inch in height at the top of the vertical section on one side only.

Retro-reflective sheeting strips shall meet the requirements of §730-05 Retro-Reflective Sign Sheeting - NYSDOT Class A and the following:

- Firmly bonded to the overlay marker with an adhesive; mechanical fasteners will not be allowed.
- Able to resist multiple impacts.

Note: Markers supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type III/IV and/or IX retro-reflective sign sheeting.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

### **729-22 TRUCK MOUNTED VARIABLE-MESSAGE SIGNS (TMVMS)**

**SCOPE.** This specification covers the physical and performance requirements for Truck Mounted Variable Message Signs (TMVMS).

**GENERAL.** TMVMS shall meet the requirements of the MUTCD and the requirements stated herein. All electrical systems in the TMVMS shall be FCC Part 15 compliant and sufficiently shielded to prevent interference with two-way radio system equipment used by the Department.

- Power System. - TMVMS shall be powered by a power source in or on the host vehicle.
- Interior Controller. - The TMVMS controller shall be mounted inside the cab of the vehicle/truck.

**DISPLAY.** The color of light emitted shall be amber. The message display area shall be a minimum of 60 inches wide and 36 inches high. TMVMS shall be capable of displaying a minimum of two lines of alphanumeric characters.

The TMVMS shall be capable of displaying:

- 8 characters per line
- At least 10” high characters per line, when displaying two lines.

The TMVMS shall be capable of displaying 2 separate panel messages in a cyclical sequence. The display shall be capable of showing a full screen view of standard highway symbols, arrows, chevrons, and 4 corner warning lights.

The TMVMS display of a flashing arrow shall conform to the legibility requirement for Type B Arrow Panels.

**TESTING.** Manufacturers or material suppliers desiring to have TMVMS considered for inclusion on the Approved List shall follow the *NYS DOT Truck Mounted VMS Certification Requirements* and submit all necessary documentation to the Director, Materials Bureau in Albany. The Certification Requirements are available on the Materials & Equipment Approved List page of the Department's website: <https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/materials-and-equipment>.

**BASIS OF APPROVAL.** TMVMS meeting the requirements of this specification and the *NYS DOT Truck Mounted VMS Certification Requirements* will be placed on the Approved List.

**BASIS OF ACCEPTANCE.** The TMVMS will be accepted on the basis of the product appearing on the Approved List and a material certification that the product meets this specification and is the same as the one appearing on the Approved List.

## **SECTION 730 - SIGNS AND DELINEATORS**

(Last Revised May, 2017)

### **730-01 ALUMINUM SIGN PANELS**

**SCOPE.** These specifications cover aluminum sign panels used as the prepared surface backing in the application of reflective sheeting for location markers, delineators and traffic signs.

**MATERIAL REQUIREMENTS.** The panel material shall be either Aluminum Alloy 6061-T6, 5154-H38, 5052-H38 or 3004-H38 and shall conform to the requirements of material specification 715-04, Wrought Aluminum.

### **FABRICATION**

**Preparation of Panel Surface for Reflective Sheeting.** The surface preparation of panels for the application of Reflective Sheeting, 730-05, shall be performed by Method I or Method II, in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

#### ***A. Method I***

##### ***1. Cleaning (Vapor or Alkaline cleaning)***

*a. Vapor Cleaning.* By total immersion of the sheeting or sign panel in a saturated vapor of trichlorethylene or perchlorethylene. Trademark printing shall be removed with lacquer thinner. Follow with a thorough rinse.

*b. Alkaline Cleaning.* Sheeting shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications. Immersion time shall depend upon the amount of soil present and the gage of the metal. Follow with a thorough rinse.

**NOTE:** After cleaning and rinsing and prior to etching, the aluminum sheeting shall be checked with a "Water Break Test" as follows: If the metal is clean, water will completely cover the surface with no breaks. Whenever water breaks, oil is present and the plate shall be recleaned until all traces of oil disappear. The surface near the edges shall be examined with extreme care for presence of oil.

##### ***2. Etching (Use Acid or Alkaline Etch)***

*a. Acid Etch.* Etch in a 6% to 8% phosphoric acid solution at 100°F. Rinse thoroughly with running cold water followed by hot water tank rinse.

*b. Alkaline Etch.* Etch the pre-cleaned aluminum surface in alkaline etching material that is controlled by titration, use time, temperature and concentration specified by the solution manufacturer. Rinse thoroughly, remove smut with an acidic chromium compound type solution as specified by the solution manufacturer and then thoroughly rinse.

#### **B. Method II**

**Cleaning and Etching.** Use a chemical conversion treatment in accordance with the requirements of Military Specification MIL-C-5541A, Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys, or later addenda. Following the etching and rinsing, panels shall be dried by a forced hot air dryer or by immersion for one minute, in circulating hot water at 180°F and allowed to air dry.

**Application of Reflective Sheeting.** The metal shall not be handled between all cleaning operations and applications of the reflective sheeting except by device or clean canvas gloves.

Immediately prior to the application of the reflective sheeting, the aluminum panel shall be prepared as specified in Method I or Method II. The reflective sheeting shall be adhered to the aluminum panel by the vacuum applicator process or mechanical process in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

**BASIS OF ACCEPTANCE.** Aluminum panels may be accepted on the basis of the manufacturer's certification that his/her product conforms to all of the above specifications. However, the Department reserves the right to conduct tests, upon aluminum panels supplied. When tests are to be made, all test samples without reflective sheeting applied shall be submitted to the Materials Bureau. The number of samples shall comprise approximately one percent of the number of panels. Each sample shall contain a minimum area of 1 square foot for each thickness of panel used. Failure of the samples to meet all the requirements of the above specifications shall be cause for rejection of the aluminum panels represented by such samples.

### **730-02 TEMPORARY PLYWOOD SIGN PANELS**

**SCOPE.** These specifications cover plywood sign panels used for temporary signs in work zones.

**MATERIAL REQUIREMENTS.** Temporary plywood sign panels shall be fabricated from exterior type plywood with a medium density overlay. Plywood shall be a minimum of 1/2 inch thick. The backs and edges of temporary plywood sign panels shall be painted white.

The surface of temporary plywood sign panels to be overlaid with reflective sheeting shall be prepared in accordance with the manufacturer's requirements.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

### **730-03 TEMPORARY RIGID LIGHTWEIGHT SIGN PANELS**

**SCOPE.** This specification covers the material requirements for rigid lightweight sign panels used in the fabrication of temporary construction signs no larger than 4 x 4 feet.

**MATERIAL REQUIREMENTS.** Temporary rigid lightweight plastic sign panels shall consist of at least two parallel surfaces of plastic, aluminum or composite separated by plastic foam, filler or stiffeners/spacers; a single piece of plastic extrusion simulating this construction; or other lightweight composites to be overlaid with reflective sheeting. External stiffeners may be used to provide strength or

to attach the panel to posts. Sign panels shall not deflect from the flat surface plane more than 1/4 inch at any point. Sign panels shall not warp and flex in a manner that reduces the required sign legibility and/or conspicuity.

If through bolting is used to attach the panel to the stiffeners, or to attach the panel directly to the posts, the bolt heads shall be provided with clear washers to minimize obscuring the legend. The backs of temporary rigid lightweight plastic sign panels shall be a uniform light color or shall be painted white.

The surface of temporary rigid lightweight sign panels to be overlaid with reflective sheeting shall be prepared in accordance with the manufacturer's requirements.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

## **730-04 (VACANT)**

## **730-05 REFLECTIVE SHEETING** (Last Revised September, 2021)

**SCOPE.** This specification covers retro-reflective sign sheeting for use in the fabrication of highway and construction signs, delineators, and other traffic control devices.

### **GENERAL.**

**NYSDOT Class A: (AASHTO M268 Type D, ASTM D4956 Type XI).** A high-intensity, prismatic, retro-reflective sheeting used for signs and other traffic control devices.

**Note:** Signs supplied before March 1, 2023, may be fabricated with NYSDOT approved ASTM D4956 Type III/IV and IX retro-reflective sign sheeting, based on the sign type.

**MATERIAL REQUIREMENTS.** Meeting the requirements of AASHTO M268 and ASTM D4956 Type XI, as well as the following:

- Be flexible, weather resistant and have a smooth surface.
- Be of good appearance, free from ragged edges, cracks, scales, blisters, or other defects.
- Allow easy cutting to specified sizes and shape
- Be solvent resistant and permit solvent cleaning. All solvents used for cleaning operations shall comply with all Federal, State, and Local air quality regulations and be recommended by the sheeting manufacturer.
- Be able to adhere to sign surfaces composed of aluminum, wood, or polymers, using adhesives and procedures as recommended by the sheeting manufacturer.

### **Accelerated Outdoor Weathering:**

- Workzone sheeting requires 1-year testing.
- All other types require 3-year testing.

### **SIGN SHEETING PACKAGING.**

Furnish retro-reflective sheeting in both rolls and sheets. Pack rolls individually. Rolls shall not contain more than four splices per 150 linear feet. Package cut sheets flat and in such a manner as to minimize any damage or defacement that may occur to the sheeting during shipment or storage. The finished sheeting surface shall show no loss of the color or retro-reflectivity with normal handling, cutting and application.



## **SIGN PANEL FABRICATION.**

Fabricate sign panels in strict accordance with the sign sheeting manufacturer's guidelines, to ensure uniform appearance and brilliance, under both nighttime and daytime conditions.

Coat and/or edge seal all backgrounds, characters, delineators, etc., in accordance with the sheeting manufacturer's recommendations. Sign panel fabrication shall be done in a manner to provide an even, clear, uniform surface, free of streaks, drops or other defects which might affect retro-reflectivity. Cut-out characters shall be of the same type sign sheeting as the background sheeting. Black cut-out characters shall be non-retro-reflective.

Sign surface generated via digital printing or screen printing shall be done using the sign sheeting manufacturer's recommended, match component system and materials, including their recommended final top coat or overlay.

Finished image sign surface shall meet the daytime color, luminance, and nighttime color requirements of this specification and 70% of the retroreflective minimum values established in this specification for its type and color.

**BASIS OF APPROVAL.** Applications for approval shall be submitted to the Materials Bureau by the manufacturer accompanied by the following:

- Three (3) – 8 inch by 11 inch samples of each color being sent in for review.
- Independent test data in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP) including accelerated outdoor weathering test results.
- Fabrication instructions, warranties and data on required printing and finishing items (i.e. printers, inks, toners, overlays).
- Certification that the product conforms to this specification.

The Materials Bureau will evaluate the submitted data and test samples of the product for color and retro-reflectivity compliance.

Upon approval by the Materials Bureau, the product will be placed on the Approved List.

## **BASIS OF ACCEPTANCE.**

Retro-reflective sign sheeting will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same material that appears on the Approved List and that it conforms to this specification.

### **730-06 THRU 730-08 (VACANT)**

### **730-09 FOR SITE MANAGER USE**

### **730-10 ACRYLIC PLASTIC REFLEX REFLECTORS**

**SCOPE.** This specification covers acrylic plastic prismatic reflectors for delineators.

## **MATERIAL REQUIREMENTS**

**Delineator Reflector Lens.** Delineator reflectors shall consist of a clear and transparent acrylic plastic face, herein referred to as the lens, with a heat plastic or plastic coated foil back fused to the lens under

heat and pressure around the entire perimeter of the lens, and the central mounting hole, to form a unit permanently sealed against dust, water, and water vapor. The lens shall consist of a smooth front surface, free from projections or indentation, other than a central mounting hole and identification, with a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light. The manufacturer's trademark shall be molded legibly into the reflector.

**Definitions and Optical Requirements**

**A. Entrance Angle.** Shall mean the angle at the reflector between the direction of light incident on it and the direction of reflector axis.

**B. Observation Angle.** Shall mean the angle at the reflector between observers line of sight and direction of light incident on the reflector.

**C. Specific Intensity.** Shall mean luminous intensity (candelas) returned at the chosen observation angle by a reflector for each footcandle of illumination at the reflector.

**Optical Test Procedure.** The reflex reflector to be tested shall be located at a distance of 100 feet from a single uniformly bright light source having an effective diameter of 2 inches the light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photo-electric photometer having a minimum sensitivity of  $1 \times 10^{-7}$  footcandles per scale division.

The photometer shall have a receiver aperture 1/2 inch diameter shielded to eliminate stray light. The distance from light source center to aperture center shall be 2 inches for 1/10 degree observation angle, and 7 inches for a degree observation angle.

If a test distance other than 100 feet is used, the source and aperture dimensions and the distance between source and aperture shall be modified accordingly.

**Seal Test.** Submerge 50 samples in water bath at room temperature. Subject the submerged samples to a vacuum of 5 inch gage for five minutes. Restore atmospheric pressure and leave sample submerged for five minutes, then examine the samples for water intake. Evidence of moisture or water intake on more than two (2) samples shall be cause for rejection of the lot represented by the samples.

**Heat Resistance.** Three reflectors shall be tested for four hours in a circulating air oven at  $175 \pm 5^{\circ}\text{F}$ . The test specimens shall be placed in a horizontal position on a grid or perforated shell permitting free air circulation. At the conclusion of the test the samples shall be removed from the oven and permitted to cool to room temperature. The samples after exposure to heat shall show no significant change in shape and general appearance when compared with unexposed control standards. No failures will be permitted.

<b>TABLE 730-10-1 OPTICAL REQUIREMENTS</b>					
<b>Observation Angle Degrees</b>	<b>Entrance Angle Degrees</b>	<b>Specific Intensity, Candela/footcandle</b>			
		<b>Crystal</b>	<b>Yellow</b>	<b>Red</b>	<b>Green</b>
1/10	0	119	71	29	29
1/10	20	47	28	11	11
1/3	0	20	12	5	5
1/3	20	8	5	2	2

**NOTE:** Failure of reflectors to equal or exceed the minimum specific intensity value shall constitute failure of the reflector being tested; failure of more than 2 reflectors out of 50 begin subjected to test shall constitute failure to the lot represented by the samples. The specific intensity of delineator reflectors shall meet the above noted values, regardless of reflector orientation.

**BASIS OF ACCEPTANCE.** Acrylic plastic reflex reflectors will be accepted on the basis of the manufacturer's certification that their product conforms to all of the above detailed specifications. However, when the Department requires that tests be made, samples shall be submitted to the Materials Bureau. Fifty-three (53) samples will be selected at random from each shipment received from the reflector manufacturer. Each shipment may contain more than one lot. These samples shall be tested as specified above. Failure of the samples to meet all the requirements of the above specifications shall be cause for rejection of delineators represented by such samples.

#### **730-11 FOR SITE MANAGER USE**

#### **730-12 (VACANT)**

#### **730-13 (VACANT)**

#### **730-14 FOR SITE MANAGER USE**

#### **730-15 THRU 730-18 (VACANT)**

#### **730-19 TEMPORARY WOODEN SIGN POSTS**

**SCOPE.** This specification covers the material requirements for temporary wooden sign posts.

**MATERIAL REQUIREMENTS.** Wooden sign posts shall be untreated surface dried redwood, red cedar, cypress or black locust; or pressure treated spruce, pine, fir, oak, birch, maple or beech. Posts shall be pressure treated in accordance with 708-31 Wood Preservative - Water Borne.

All 4 x 6 inch posts shall have two 1 1/2 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches above grade and filled with flexible caulk. All 6 x 8 inch posts shall have two 3 inch diameter breakaway holes drilled through the center of the post parallel to the sign face 4 inches and 18 inches above grade and filled with flexible caulk.

**BASIS OF ACCEPTANCE.** Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

#### **730-20 DELINEATOR, REFERENCE MARKER AND SNOWPLOWING MARKER POSTS**

**SCOPE.** These specifications cover the material requirements for steel posts used to support delineators, reference markers, and snowplowing markers.

#### **MATERIAL REQUIREMENTS.**

Posts shall be fabricated of steel meeting the requirements of §715-01 Structural Steel or any of the following steel types:

ASTM A1

ASTM A36

ASTM A499 (Grade 60, Grade 70, Grade 80SP)

ASTM A500 (Grade B)

ASTM A570 (Grade 60)

ASTM A653 (Grade 55)

ASTM A1011

After fabrication (punching, drilling, etc.) all steel posts shall be galvanized, and all damage to the galvanized surfaces due to handling, shipment, erection, etc., shall be repaired, in accordance with the applicable requirements of §719-01 Galvanized Coatings and Repair Methods.

**BASIS OF ACCEPTANCE.** Posts will be accepted on the basis of a material certification that the product conforms to this specification.

### **730-21 FLEXIBLE DELINEATOR POSTS**

**SCOPE.** This specification covers the material, fabrication, and performance requirements for flexible delineator posts.

**MATERIALS REQUIREMENTS.** Flexible delineator posts shall be supplied with reflective sheeting of a size and color as required by the contract documents. The color of the posts shall match the color of the reflective sheeting unless otherwise specified in the contract documents. Where double unit reflectors are specified, elongated reflective sheeting may be substituted as in accordance with the MUTCD.

Reflective sheeting shall be fabricated of a material conforming to the requirements of §730-05 Reflective Sheeting, Class B, Class C, or Class E. Sheeting shall be applied in accordance with the sheeting manufacturer's written instructions.

**TESTING.** Flexible delineator posts shall meet the requirements in the procedural directives of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Application for approval of flexible delineator posts shall be submitted to the Materials Bureau. The procedural directives outlining detailed requirements and procedures for approval are available from the Materials Bureau. Upon approval the name of the flexible delineator post will be placed on an Approved List.

Project acceptance will be based on the manufacturer's name and type of flexible delineator post appearing on the Department's Approved List titled Flexible Delineator Posts.

### **730-22 STIFFENERS, OVERHEAD BRACKETS AND MISCELLANEOUS HARDWARE** (Last Revised May, 2019)

**SCOPE.** These specifications cover the material requirements for stiffeners, overhead brackets and miscellaneous hardware used for signs.

#### **MATERIAL REQUIREMENTS**

**Aluminum Components.** Horizontal sign panel stiffeners (Z bars) and overhead panel brackets shall be fabricated of aluminum alloy 6061-T6.

Other miscellaneous hardware including vertical stiffeners, bolts, nuts, washers, screws, rivets, pull-type lockbolts and serrated or knob stem blind rivets shall be fabricated of the materials and in the manner shown on the plans or standard sheets and shall meet the requirements of 715-04, Wrought Aluminum.

Components designated as Alloy 2024-T4 shall be given a Type 205 coating in accordance with 719-02, Aluminum Anodic Coatings.

Certification, Sampling, Testing and Inspection of aluminum components shall be handled as noted in 715-04.

**Steel Components.** Steel bolts, nuts and washers referenced to this specification shall conform to the requirements of Table 730-22-1 unless otherwise specified.

Bolts, nuts and washers to be used in contact with aluminum shall be coated with cadmium or cadmium/tin combination.

All cadmium and cadmium/tin coatings shall be given a chromate treatment in or with an aqueous solution of salts, acids or both to produce a protective chromate coating. The chromate coating shall be distinctly colored iridescent yellow to bronze for cadmium. Cadmium/tin coatings, when given this iridescent chromate treatment, may remain silver colored. Usual chromic and nitric acid bright dips are not chromate treatments.

<b>TABLE 730-22-1 STEEL FASTENERS</b>						
<b>Bolt (<math>\emptyset</math>)</b>	<b>Bolt Size (in)</b>	<b>Allowable Nuts<sup>1</sup> (ASTM A563M)</b>	<b>Bolt, Nuts &amp; Washer Coating Systems<sup>2</sup></b>	<b>Plain Washer</b>	<b>Prevailing Torque Hex Nuts And Hex Flange Nuts<sup>3</sup></b>	<b>Lock Washer</b>
A307	1/4 to 1 1/2 1 3/4 to 4	5 - H1 5 - HH	P or Z P or Z	< M12, use ANSI B18.22M, soft $\geq$ M12, use ASTM F436M IFI 542 or ANSI B18.22M, hard only	CLASS 5,9 or 10	General Motors Standard Metric Helical Spring General Specification
F3125 GRADE A325 or A449	5/8 to 1 1/2 1 3/4 to 4	9 - H2 12 - H2 9 - HH 12 - HH	P Z P Z		CLASS 5,9 or 10	
A354 Grade BD or A490 Type 1 or 3	1/4 to 1 1/2 1 3/4 to 4	10 - H1 12 - HH	P P or Z		CLASS 9 or 10	

**NOTES:**

- Class of nut (5,9,10 and 12):  
H1 ANSI B18.2.4.1M hex nut, style 1  
H2 ANSI B18.2.4.2M hex nut, style 2  
HH ANSI B18.2.4.6M heavy hex nut
- P > 7/16": ASTM B695, class 50, type 1  
P  $\leq$  7/16": ASTM B695, class 40, type 1, cadmium coating  
ASTM B696, class 8, type 2  
ASTM B766, class 12, type 2, cadmium/tin coating  
ASTM B635, class 8, type 2  
Z > 7/16": ASTM A153, class C  
Z  $\leq$  7/16": ASTM A153, class D
- ANSI B18.16.1M

**BASIS OF ACCEPTANCE.** Acceptance will be based on the manufacturer's certification that its product conforms to these specifications.

**730-23 FIBERGLASS REINFORCED PLASTIC SIGN PANELS**

**SCOPE.** This specification covers the material requirements for fiberglass reinforced plastic for use as a sign panel substrate.

**GENERAL.** The fiberglass reinforced plastic sign panel shall be fiberglass reinforced thermoset polyester laminate. The panel shall be acrylic modified and UV stabilized for outdoor weatherability. The panel shall be stabilized so as not to release migrating constituents (i.e., solvents, monomers, etc.) over time, and shall contain no residual release agents on the surface of the laminate that will interfere with any subsequent bonding operations. The panel shall not contain visible cracks, pinholes, foreign inclusions, or surface wrinkles that would affect implied performance, alter the specific dimensions of the panel or otherwise affect its serviceability.

**MATERIALS REQUIREMENTS**

**Physical Requirements.** The fiberglass reinforced plastic sign panel materials shall conform to the physical requirements in Table 730-23-1:

<b>TABLE 730-23-1 PHYSICAL REQUIREMENTS FOR FRP SIGN PANELS</b>			
<b>Property</b>	<b>ASTM Test Method</b>	<b>Requirement</b>	
		<b>Min.</b>	<b>Max.</b>
Tensile Strength	D638	10.0x10 <sup>3</sup> psi	--
Tensile Modulus	D638	1.2x10 <sup>6</sup> psi	--
Flexural Strength	D790	20.0x10 <sup>3</sup> psi	--
Flexural Modulus	D790	1.2x10 <sup>6</sup> psi	--
Compression Strength	D695	32.0x10 <sup>3</sup> psi	--
Compression Modulus	D695	1.4x10 <sup>6</sup> psi	--
Punch Shear	D732	13.0x10 <sup>3</sup> psi	--
Weatherability C Grade II	D3841	26	44
Impact Resistance	D3841	60 ft	--

**Panel Flatness Test.** Panel flatness shall be determined by supporting a 30 x 30 inch panel at two opposite corners, the maximum deflection measured diagonally, parallel and perpendicular to the panel by lines drawn through the center of the panel, shall not exceed 1/2 inch. The panel shall then be supported in a like manner in an oven for 48 hours at 180°F. The maximum deflection shall again be measured as previously noted, and shall not exceed 1/2 inch. All measurements shall be made when the panels are at ambient temperature.

The fiberglass reinforced plastic panel shall have a maximum Coefficient of Thermal Expansion of 1.8x10<sup>-5</sup> in/in/°F and maintain its strength and impact resistance qualities over a temperature range of -65°F to 212°F.

**Application of Reflective Sheeting.** The reflective sheeting shall be adhered to the fiberglass reinforced plastic panel in strict accordance with the recommendations of the manufacturer of the reflective sheeting.

**BASIS OF ACCEPTANCE.** Application for approval of fiberglass reinforced plastic sign panel by the producer shall be submitted to the Materials Bureau accompanied by a 80 square feet sample of the product. Upon approval by the Materials Bureau, the name of the product will be placed on the Department's Approved List entitled AFiberglass Reinforced Plastic Sign Panels 730-23.

### **730-24 TYPE A SIGN SUPPORTS**

**SCOPE.** This specification covers the material and fabrication requirements for breakaway supports used for roadside signs.

**MATERIAL, FABRICATION AND PERFORMANCE REQUIREMENTS.** Post material, fabrication and performance requirements shall be in accordance with the standard sheets, the appropriate Materials Details and the procedural directives of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Type A Sign Supports shown on the standard sheets shall be accepted based on the manufacturer's certification that its product conforms to these specifications and the appropriate standard sheets.

All other Type A Sign Supports will be accepted on the basis of their listing on the Department's Approved List of Type A Sign Supports. In addition, the manufacturer or supplier shall provide two

copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least ten days prior to the use of the product.

### **730-25 TYPE B SIGN POSTS**

**SCOPE.** This specification covers the material requirements for Type B Sign Posts and Rustic Type B Sign Posts. These sign posts shall be equipped with breakaway bases and hinge assemblies per 730-26, Breakaway Bases and Hinge Assemblies, if installed at a location subject to vehicle impact.

### **MATERIALS AND FABRICATION REQUIREMENTS**

**Steel Sign Posts.** Steel for sign posts and attachments to or components of sign posts shall be ASTM A36, A242, A572 Grade 50 and A588 and shall conform to 715-01 Structural Steel. Rustic Type B Sign Posts shall be ungalvanized weathering steel, ASTM A588 or A242, meeting the requirements of 715-01 Structural Steel.

Sign posts, except Rustic Type B Sign Posts, shall be galvanized after fabrication (punching, drilling, welding, cutting, etc.) in accordance with 719-01, Galvanized Coatings and Repair Methods. Damage to galvanized surfaces of steel posts due to handling, shipment, erection, etc. shall be repaired as described in Repair of 719-01, when directed by the Engineer.

Sign posts with breakaway bases shall be of weldable quality, and all welding shall be in accordance with the provisions of the section on 'Fabrication' of the New York State Steel Construction Manual.

**FABRICATION.** Sign posts shall be fabricated as indicated on the standard sheets. Breakaway bases shall conform to the requirements of 730-26, Breakaway Bases and Hinge Assemblies.

**BASIS OF ACCEPTANCE.** Acceptance shall be based on the manufacturer's certification that the product conforms to these specifications.

### **730-26 BREAKAWAY BASES AND HINGE ASSEMBLIES**

**SCOPE.** This specification covers the material and fabrication requirements for bi-directional and omni-directional breakaway bases and hinge assemblies for use on Type B Sign Posts and for use on Rustic Type B Sign Posts.

Bi-Directional Breakaway Bases and Hinge Assemblies are intended for use when the expected impact angle is within 30 degrees of the axis of the base from the front and rear.

Omni-Directional Breakaway Bases and Hinge Assemblies are intended for use whenever the expected impact angle may be greater than 30 degrees, measured as described above.

**MATERIAL AND FABRICATION REQUIREMENTS.** Breakaway bases and hinge assemblies shown on standard sheets shall satisfy the following requirements:

Steel for breakaway bases and hinge assemblies shall be A-36, A242, A572 Grade 50, A588 and shall meet the requirements of 715-01, Structural Steel. Steel shall be of weldable quality. Fasteners shall be of the size and shape shown on the Standard Sheets and meet the requirements of 730-22, Stiffeners, Overhead Brackets and Miscellaneous Hardware. Breakaway bases and hinge assemblies shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, after the base is welded to the post. Welding shall be in accordance with the provisions of the section on 'Fabrication' of the 'New York State Steel Construction Manual.' Fabrication details shall be in accordance with the standard sheets.

Breakaway bases and hinge assemblies for use in conjunction with rustic sign posts shall meet the above requirements with the following exceptions:

- The upper slip base plate and attached post shall be ungalvanized weathering steel, ASTM A588 or A242, meeting the requirements of 715-01, Structural Steel. The lower slip base plate, and the attached stub portion of the post, shall be galvanized steel. The remainder of the slip base shall be as shown on the contract drawings.
- When used on one-way, divided roadways, the back flange hinge plate shall be ungalvanized A588 or A242 steel installed as shown on the contract drawings. When used on two-way, undivided roadways, the back flange hinge plate shall meet the requirements, below, of the front flange hinge plate.
- The front flange hinge plate shall be galvanized steel, except that an additional galvanized steel flat washer meeting the requirements of ASTM F436 shall be installed on all four bolts between the post and the hinge plate to assure proper slippage.

All exposed galvanized surfaces, except in the vicinity of the slots in the hinge plates, shall be painted in accordance with §657 *Painting Galvanized and Aluminum Surfaces*.

**BASIS OF ACCEPTANCE.** Breakaway bases and hinge assemblies fabricated as shown on the standard sheets shall be accepted based on the manufacturer's certification that the complete assembly conforms to these specifications.

### 730-27 PERMANENT VARIABLE MESSAGE SIGNS

**SCOPE.** This specification gives minimum material, fabrication, fatigue and strength requirements of variable message signs for permanent installation. Other requirements are in the Contract Documents.

Within this specification, "overhead" shall mean to be mounted over the traveled way, or what the plans indicate will become the traveled way.

### MATERIAL REQUIREMENTS

**Housing.** The enclosure housing shall be constructed of aluminum alloy 3003-H14, 6061-T6, 5154-H38 or as specified on approved shop drawings. The minimum thickness shall be 1/8 inch. Seams shall be continuously welded by an inert gas process only in the shop.

The housing shall be completely sealed to prevent the entry of water, insects, dust, dirt and corrosion. Neoprene gaskets shall be utilized as necessary.

Readily-available, changeable filtration devices shall be provided at drain holes and at all points where forced air enters the enclosure.

All hinged access panels and windows shall be equipped with hold-open devices which shall not release accidentally or by the action of wind. The hold-open devices shall not interfere with the operation of the display, nor with the repair or replacement of user serviceable components.

**Stiffeners, Hardware and Mounting Brackets.** Hardware, framing members and mounting brackets shall meet the requirements of 730-22, unless indicated otherwise on the manufacturer's shop drawings approved by the Engineer.

Framing structural members shall be made of aluminum alloy 6061-T6 or an approved equivalent. All hardware shall be corrosion-resistant steel or protected from corrosion by suitable plating. Fasteners for securing access panels shall be captive.

### MANUFACTURING

**General.** Fabrication shall be such that performance will not be impaired after the equipment has been subjected to shock and vibration caused by normal installation, transportation and maintenance handling. Particular attention shall be given to neatness and thoroughness of soldering, wiring, welding, plating,



riveting, finishes and machine operations. All parts shall be free from burrs and sharp edges or any other defect that could make the part or equipment unsatisfactory for the operation or function intended in this specification.

Modules shall be designed such that major portions may easily be replaced. Modules of unlike functions shall be mechanically keyed to prevent insertion into the wrong socket or connector. All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance. They shall be readily accessible for inspection and maintenance, using simple hand-held tools and standard meters.

**Housing.** The sign enclosure including doors and access panels shall be designed and constructed so as to present a clean, neat appearance; be smooth with exterior corners rounded; be weatherproof and vandal-resistant; and be free of burrs, blemishes and unspecified holes.

Drainage holes shall be drilled near each corner of the base of the enclosure.

The enclosure shall have internal lighting sufficient for all maintenance activity requirements of the VMS and 120 volt power receptacles every 10 feet mounted on the rear interior panels.

If the variable message sign is designated as "walk-in," then its access door shall be a minimum of 24 inches wide x 60 inches high.

## **Environmental**

**A. Temperature.** Internal temperature shall be continuously monitored whenever electric power is applied to the sign. The internal temperature of the enclosure shall be reported to the local and central controller upon request. Ventilation shall be automatically turned on and off at internal temperatures specified in the Proposal. Exhaust and intake ports shall be protected by filter screens against moisture, dust and insect intrusion. The ventilation system shall be sufficient to circulate three times the volume of air inside the enclosure per minute. Multiple fans or blowers shall be used to provide the specified venting and shall be located within the enclosure to minimize heat stratification.

**B. Adverse Conditions.** The equipment shall meet all of its specified functions during and after subjection to any combination of the following conditions:

- 1. Ambient Temperature.** Range of -22°F to +145°F.
- 2. Temperature Shock.** 60°F per hour, during which the relative humidity shall not exceed 95%.
- 3. Relative Humidity Range.** 0 to 95% over the temperature range of 40°F to 110°F.
- 4. Moisture Condensation.** On all surfaces.

**C. Ambient Light.** The variable message sign shall be equipped with light sensors so that the display shall be able to automatically adapt its level of light output to maintain readability under varying ambient light conditions. There shall be a minimum of eight (8) levels of dimming, linearly spaced from nighttime to daylight brightness. The sign's automatic dimming control shall be overridable by central control. The dimming circuitry shall automatically compensate for variations in the AC line voltage to maintain the light output constant for the selected brightness level.

The levels of lighting shall produce luminance measured on the optic axis, as follows:

- 1. Daylight.** A minimum of 14 candela per pixule for typical daylight environment.
- 2. Nighttime.** Between 1.5 and 2 candela per pixule for nighttime environment.

**Electrical Protection.** The equipment shall contain readily-accessible, normally resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

**Electronic Components.** All components shall be UL listed. All printed circuit boards shall be FR4 or G10 fiberglass epoxy material, with 2 oz. copper, double-sided with plated through-holes.

All etched connector fingers are to be plated with a minimum thickness of 100 micro-inches of gold over nickel.

Board connectors that are not an integral part of the printed circuit are to be plated with a minimum thickness of 15 micro-inches of gold over nickel.

**Sign Face.** In order to increase contrast, the pixules shall be arranged on a black, non-glossy background. All electronic components visible from outside the sign shall be of black color or coated with black, non-glossy paint.

The front of the sign shall be enclosed by a protective, weathertight face, 1/4 inch thick.

Variable spacing between letters shall approximate the recommended spacing for 18 inch Series E sign text found in the Federal Highway Administration Standard Alphabets for Highway Signs.

**DESIGN CRITERIA.** Design loads used in the design of the connection and mounting elements of the sign enclosure shall be as specified in the most current *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

**SUBMITTALS.** When details of the connection of the Permanent Variable Message Sign to the sign structure are not included in the Contract Documents, the Contractor shall submit shop drawings to the DCES for approval, detailing how to mount and connect the variable message sign enclosure to the structure. Shop Drawings shall be submitted in accordance with the SCM. Shop Drawings may be submitted electronically to [dces.metals@dot.ny.gov](mailto:dces.metals@dot.ny.gov). If the shop drawings are approved by the Department, the contractor will be notified by electronic mail.

#### **DELIVERY AND INSTALLATION**

The contractor shall deliver, store, handle, and install all materials and equipment in such a manner as not to degrade quality, serviceability or appearance. Material to be stored shall be stored in a clean and dry location free from construction dust, precipitation, and condensing moisture. Any part of the equipment damaged during transportation, handling, or installation shall be repaired, or if determined by the Engineer as unfit for use in the finished work, shall be removed from the site and replaced by the Contractor at no additional cost.

All materials shall be delivered and stored in the manufacturer's original unopened protective packages and protected against soiling, physical damage, or wetting, before and during installation. Unloading and unpacking of all materials shall be done in a manner to prevent misalignment or damage.

The installation shall be performed by factory certified personnel. Installation shall be complete in all respects, including all framing and all related fastenings and anchors required for a complete installation. Equipment shall be placed in accordance with the general arrangement as shown on the Drawings. The general arrangement may be modified only as required to suit specific equipment. Modifications shall not affect the design of components. Layout dimensions as shown on the Drawings may be modified to improve operating efficiency.

**MARKING.** The contract number, pay-item number, and month and year of installation shall be marked using permanent ink, paint, or stamping into the wall. Characters shall be 1 to 1 3/4 inches high, horizontal when the variable message sign is in its final position, and be located in the following locations:

- The end panel of the vms, so as to be visible from the shoulder closest to the variable message sign.

- On the inside of a "walk-in" variable message sign, near the middle of the panel opposite the door.

Also, the manufacturer's name, product name, model number, serial number, and city and state or province of manufacture shall be permanently marked on the outside and an easily accessible location inside the variable message sign.

These markings shall not be visible when viewing the front of the variable message sign straight-on.

**BASIS OF ACCEPTANCE.** Permanent Variable Message Signs will be accepted on the following basis:

- Submission and approval of shop drawings for each different variable message sign supplied.
- Submission and approval of shop drawings, including mounting details of Permanent Variable Message Sign to sign structure.
- Manufacturer's certificate of compliance to these specifications including compliance to the most current *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.
- If required by the contract documents, submission of mill certifications for structural elements.
- Passing all performance tests as specified in the contract documents.

Final inspection and acceptance of equipment shall be made after installation at the locations specified in the contract documents.

## **730-99 FOR SITE MANAGER USE**

### **SECTION 731 - SUBSURFACE TENSILE ELEMENTS**

#### **731-01 SOIL NAIL TENDON ASSEMBLY**

**SCOPE.** This specification covers the material requirements for the components for assembling a soil nail tendon generally used in a Soil Nail Wall System (SNWS) to internally stabilize a cut and/or underpin a structure.

#### **MATERIAL REQUIREMENTS.**

**A. SNWS Temporary.** Provide materials meeting the following requirements:

- 1. SNWS Nail Tendons.** Provide clean, straight, rust-free tendons meeting the following:
  - a. Solid Bar Soil Nail (SBSN).** Provide solid bar tendons meeting AASHTO M31 of Grade 60 or 75, ASTM A722 for Grade 150. The deformed bar, continuous without splices or welds, undamaged, bare or epoxy coated or encapsulated (as shown on the approved Working Drawings), shall be threaded a minimum of 6 in. on the wall anchorage end to allow proper attachment of bearing plate and nut. Threading may be continuous spiral, deformed ribbing provided by the bar deformations (continuous threadbars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, the bar shall be sized based on the net throat of the threads. Hollow bars are not allowed.
- 2. SNWS Centralizers.** Provide centralizers manufactured from Schedule 80 PVC pipe or tube, steel, or any material not detrimental to the nail steel, except that wood shall not be used, and approved by the Engineer.

3. **SNWS Bar Couplers.** Provide bar couplers capable of developing 100% of the Guaranteed Ultimate Tensile Strength (GUTS) of the bar as certified by the manufacturer.

**B. SNWS Permanent.** Provide materials meeting the requirements §731-01 A. *SNWS Temporary* with the following additions and exceptions

1. **SNWS Nail Tendon Double Corrosion Protection.** In addition to covering the bar with grout, provide an additional level of corrosion protection consisting of:
  - a. **Epoxy Coating.** Provide epoxy coating conforming to the requirements of §709-04 *Epoxy-Coated Bar Reinforcement*. The Bend Test requirements are waived, or
  - b. **Encapsulation.** Provide a minimum 40 mil thick corrugated HDPE tube conforming to AASHTO M252 or corrugated PVC tube conforming to ASTM D1784, Class 13464-B. Encapsulation shall provide at least 3/16 in. of grout cover over the nail bar and be resistant to ultraviolet light degradation, normal handling stresses, and grouting pressures. Factory fabrication of the encapsulation is preferred. Upon the Engineer's approval, the encapsulation may be field fabricated if done in strict accordance with the manufacturer's recommendations.

**BASIS OF APPROVAL.** Soil Nail Tendons will be approved based on the evaluation of the design submittal detailing the requirements of the assembly.

**BASIS OF ACCEPTANCE.** Soil nail centralizers, epoxy coating or encapsulation will be accepted on the basis of a material certification that the product conforms to this specification. Solid bar nail tendons and bar couplers (if allowed) will be accepted on the basis of a material certification that the product conforms to this specification and certified mill test results from each heat specifying the ultimate strength, yield strength, elongation, and composition indicating conformance to the design submittal and specification.

## 731-02 GROUTED TIEBACK ASSEMBLY

**SCOPE.** This specification covers the material requirements for the components for assembling a grouted tieback generally used in a Grouted Tieback System (GTS) to internally stabilize and supplement the resisting force of an external support system retaining a cut and/or underpinning a structure.

### MATERIAL REQUIREMENTS.

**A. GTS Temporary.** Provide materials meeting the following requirements:

1. **GTS Tendons.** Provide clean, straight, rust-free tendons meeting the following:
  - a. **Wire Tendons.** "Uncoated Seven-Wire Stress Relieved Strand for Prestressed Concrete" - ASTM A416, or "Uncoated Seven-Wire Compacted Stress Relieved Strand for Prestressed Concrete" - ASTM A779, or
  - b. **Solid Bar.** Continuously threaded "Uncoated High-Strength Steel Bar for Prestressing Concrete" - ASTM A722. Hollow bars are not allowed.

The GTS tendons shall be of such size that the design load does not exceed 53% of the Guaranteed Ultimate Tensile Strength (GUTS) of the tendons.

2. **GTS Couplers.** Provide couplers for tendons capable of developing 100% of the GUTS.
3. **GTS Sheath.** Provide a sheath for corrosion protection encasing the entire stressing length of the tendon. Acceptable sheaths for the stressing length shall be one of the following:
  - a. A polyethylene (PE) tube applied over a corrosion inhibiting grease coated strand. The polyethylene shall be Type II, III or IV as defined by ASTM D1248. The tubing shall have a minimum wall thickness of 60 mils.
  - b. A hot-melt extruded polypropylene tube applied over a corrosion inhibiting grease coated strand. The polypropylene shall PP 210 B55542-11 as defined as ASTM D4101. The tubing shall have a minimum wall thickness of 60 mils.
  - c. A corrugated PVC tube applied over a corrosion inhibiting grease coated strand. The PVC tube shall conform to ASTM D1784 Class 13464-B. The tubing shall have a minimum wall thickness of 60 mils.
  - d. A heat shrinkable tube coated with an elastic adhesive applied over bar tendons. Prior to shrinking the tube shall have a nominal wall thickness of at least 24 mils and the elastic adhesive inside the tube shall have a nominal thickness of 20 mils. A smooth bond breaker shall be placed around the heat shrinkable tube in the free length.
4. **GTS Grease.** Provide a grease compound for corrosion inhibiting and lubricating properties to completely cover the steel in the stressing length. Provide grease for the stressing length meeting the requirements shown in Table 731-02-1 *Grease Properties*:

<b>TABLE 731-02-1 GREASE PROPERTIES</b>			
<b>Property</b>		<b>Test Method</b>	<b>Acceptance Criteria</b>
Dropping Point		ASTM D566	Minimum 300° F
Oil Separation @ 160° F		FTMS 791B Method 321.2	0.5% Maximum by mass
Water Content		ASTM D95	0.1% Maximum
Flash Point		ASTM D92	Minimum 300° F
Accelerated Corrosion Test: 5% Salt Fog @ 100° F @ 5 mil, min. hrs, Q Panel Type S		ASTM B117	Rust Grade 7 or better after 1000 hrs. of exposure according to ASTM D610
Water Soluble Ions	Chlorides	ASTM D512	10 ppm Maximum
	Sulfides	ASTM D4500-S <sup>2</sup> E	10 ppm Maximum
	Nitrates	ASTM D3867	10 ppm Maximum
Soak Test: 5% Salt Fog @ 100° F @ 5 mil coating, Q Panel Type S. (Immerse panels 50% in a 5% salt solution and expose to salt fog).		ASTM B117 (modified)	No emulsification of the coating after 720 hrs. of exposure.
Sheathing Compatibility: 40 days @ 150° F	Hardness Change	ASTM D4289	15% Change
	Volume Change	ASTM D4289	10% Change
	Tensile Strength Change	ASTM D638	30% Change

5. **GTS Centralizers and Spacers.** Provide centralizers and spacers consisting of plastic, steel or any material not detrimental to the tendon. Wood shall not be used. Centralizers and spacers shall permit free flow of grout. Combination centralizer/spacers will be permitted.
6. **GTS Trumpet.** Provide a trumpet integral with the bearing plate. The trumpet shall consist of an epoxy coated steel pipe or tube conforming to the requirements of ASTM A53 for pipe or ASTM A500 for tubing. The trumpet shall have an inside diameter equal to or larger than the hole in the bearing plate, and shall be long enough to accommodate movements of the structure during loading and testing. For encapsulated strand tendons, the trumpet shall be long enough to enable the tendon to make a transition from the diameter of the tendon in the stressing length to the diameter of the tendon at the anchor head without damaging the encapsulation. A seal to retain grease or grout within the trumpet shall be provided between the trumpet and the stressing length corrosion protection. If grout is used to fill the trumpet, then the seal shall be a deformable seal. If grease is used to fill the trumpet, a description of the seal shall be submitted to the Engineer for approval.

**B. GTS Permanent.** Provide materials meeting the requirements §731-02 A. *GTS Temporary* with the following additions and exceptions

1. **GTS Encapsulation.** Provide an additional level of corrosion protection for the GTS Tendon consisting of:
  - a. **Encapsulation.** Provide encapsulation consisting of a tube of corrugated PVC, high density polyethylene or steel. The encapsulation shall have sufficient thickness to resist damage due to shipping, handling and installation.

**BASIS OF APPROVAL.** Grouted Tiebacks will be approved based on the evaluation of the design submittal detailing the requirements of the assembly.

**BASIS OF ACCEPTANCE.** Grouted Tieback Assembly will be accepted on the basis of a Material Certification for the grouted tieback centralizers and spacers, encapsulation, sheath, trumpet, and grease compound.

Grouted tieback tendons and couplers (if allowed) will be accepted on the basis of a material certification and certified mill test results from each heat specifying the ultimate strength, yield strength, elongation, and composition indicating conformance to the design submittal and this specification.

### **731-03 ROCK BOLT ASSEMBLY** (Last Revised May 2019)

**SCOPE.** This specification covers the material requirements for the components for assembling a rock bolt generally used in reinforcing a rock slope or as part of a rock catchment system. The following materials are evaluated in this specification:

- 731.0301 – Resin Rock Bolt Assembly, 1 in. Diameter Steel Bar
- 731.0302 – Resin Rock Bolt Assembly, 1 ¼ in. Diameter Steel Bar
- 731.0303 – Resin
- 731.0304 – Cement Grouted Rock Bolt Assembly, 1 ¼ in. Diameter Steel Bar

### **MATERIAL REQUIREMENTS.**

**A. Bolts.** Provide bolts of at least Grade 150 (ASTM A722) prestressing steel of the diameter shown in the contract documents. Bolts must have rolled thread-like deformations over the entire length.

**B. Appurtenances.** Provide appurtenances as recommended by the bolt manufacturer for the size and grade bolt supplied, consisting of a steel bearing plate, a hardened washer, if required, and a convex bottom anchor nut. Two beveled or wedge washers per bolt may be required. The upper, or bearing washer, shall be countersunk on the side opposite the bevel to match the bottom of the anchor nut.

For cement grouted rock bolts, furnish trumpets (for single stage grouting), schedule 40 PVC sleeve, grease/wax gel corrosion protection, centralizers, grout tubes, grout sealers, and anchor head protection as recommended by the bolt manufacturer.

**C. Resin.** Provide resin of the two-component type, and of two different setting times, specifically manufactured for rock bolting. Use only resin that is within the unexpired shelf life designated on the package by the manufacturer.

Provide cartridges of the appropriate diameter as recommended by the manufacturer for the bolt/drill hole/cartridge diameter combination used. Furnish sufficient fast setting resin to fill 3 ft. of annular space in the bottom of the hole. Greater amounts of fast setting resin will be necessary in some rock types to meet the pull test requirements. Furnish slower setting resin with a setting time of no less than fifteen minutes. Install enough slow setting resin in the remainder of the hole to fully encapsulate the bolt.

**D. Grout.** Provide grout consisting of concrete grouting material conforming to the requirements of §701-05 *Concrete Grouting and Anchoring Material*.

**BASIS OF ACCEPTANCE.** Rock bolts and appurtenances will be accepted on the basis of a material certification that the product conforms to this specification and certified mill test results from each heat specifying the ultimate strength, yield strength, elongation, and composition indicating conformance to the specification. Larger diameter bolts are acceptable if supplied at no additional cost to the State.

Rock bolt resin will be accepted on the basis of a material certification that the product conforms to this specification.

Rock bolt cement grout will be accepted in accordance with the requirements of §701-05 *Concrete Grouting and Anchoring Material*.

## **731-15 FOR SITE MANAGER USE**

### **SECTION 732 - DRILLING**

#### **732-01 DRILL RIGS**

**SCOPE.** This specification covers the equipment and performance requirements for drill rigs.

**GENERAL.** Drill rigs shall be specifically designed and manufactured for drilling, coring and sampling soil and rock.

**EQUIPMENT.** Drill rigs shall have adequate capacity and power to accomplish the required work. Each rig shall be supplemented with the necessary auxiliaries, appurtenances, tools and other equipment required for proper operation.

**BASIS OF ACCEPTANCE.** The rigs and all necessary auxiliaries, appurtenances, tools, barges, platforms, support vessels and equipment shall be acceptable to the Engineer. Drill rigs that are not adequate, as determined by the Engineer, will not be permitted for use. Drill rigs required under the items

for furnishing equipment including drive hammers, all necessary auxiliaries, appurtenances, tools, barges, platforms, support vessels and other equipment must be on site, inspected and approved by the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau before any work is done by that rig. Each rig shall be complete and sharing of equipment between rigs will not be permitted.

**732-02 DRIVE PIPE**

**SCOPE.** This specification covers the material and quality requirements for drive pipe used in subsurface explorations.

**MATERIAL REQUIREMENTS.** Drive pipe shall be extra strong steel pipe, 2 1/2 inch or 4 inch nominal diameter as specified, with threaded ends in random 5 foot lengths and shall conform to the requirements of ASTM A120, Schedule 80.

**BASIS OF ACCEPTANCE.** Drive pipe shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

**732-03 CASING**

**SCOPE.** This specification covers the material and quality requirements for casing used in subsurface explorations.

**MATERIAL REQUIREMENTS.** The casing shall be diamond drill flush-joint or flush coupled type, fabricated from high quality seamless steel tubing conforming to the requirements of the Diamond Core Drill Manufacturer's Association (DCDMA) Standards. The design shall permit any size casing to telescope into the next larger size.

**BASIS OF ACCEPTANCE.** Casing shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

**732-04 SAMPLERS**

**SCOPE.** This specification covers the material requirements for split barrel samplers.

**MATERIAL REQUIREMENTS.** Samplers shall be equipped with a ball check in the head section and have a minimum inside length of 20 inches. Samplers shall conform to the following sizes:

<b>Sampler Diameter (Inches)</b>	<b>Outside Diameter (Inches)</b>	<b>Cutting Shoe Opening (Inches)</b>
2	2	1 <sup>3</sup> / <sub>8</sub>
2½	2½	1 <sup>7</sup> / <sub>8</sub>
3	3	2 <sup>3</sup> / <sub>8</sub>
3½	3½	2 <sup>7</sup> / <sub>8</sub>

**BASIS OF ACCEPTANCE.** Samplers shall be subject to the inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

**732-05 THIN WALL SAMPLE TUBES**

**SCOPE.** This specification covers the material and quality requirements for thin wall sample tubes.



**MATERIAL REQUIREMENTS.** Thin walled sample tubes shall be fabricated from Type 304 stainless steel tubing meeting the requirements of ASTM A276 as specified for a nominal 3 1/2 inch O.D. seamless or welded tubing with nominal 0.065 inch wall thickness. Specific dimensions and fabrication details shall comply with the current Geotechnical Engineering Bureau Drawing entitled “Stainless Tube for 3 1/2 inch Undisturbed Soil Samples.” Liners for 3 1/2 inch samplers shall have an outside diameter of 3 inches and shall be 18 inches long. Liners shall be fabricated of brass or stainless steel only.

**BASIS OF ACCEPTANCE.** Sample tubes shall be subject to the inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

### **732-06 CORING BITS**

**SCOPE.** This specification covers the material requirements for coring bits used in Subsurface explorations.

**MATERIAL REQUIREMENTS.** Coring bits shall be four sizes: AX, BX, NX and HX. The bits shall meet the outside diameter requirements specified by the National Bureau of Standards and the Diamond Core Drill Manufacturer's Association.

**BASIS OF ACCEPTANCE.** Coring bits shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

### **732-07 SAMPLE STORAGE BAGS**

**SCOPE.** This specification covers the material requirements for sample storage bags used for containing soil samples.

**MATERIAL REQUIREMENTS.** Sample storage bags shall be moisture-proof, transparent, plastic bags with minimum dimensions of 8 inches long, 10 inches wide and 2 mils thick.

**BASIS OF ACCEPTANCE.** Sample storage bags shall be subject to inspection and approval of the Engineer.

### **732-08 SAMPLE JARS**

**SCOPE.** This specification covers the material requirements for sample jars used for containing soil samples.

**MATERIAL REQUIREMENTS.** Sample jars shall be glass, or plastic, wide-mouthed jars of one-quart capacity with air-tight screw covers fitted with rubber compo-lined caps.

**BASIS OF ACCEPTANCE.** Sample jars shall be subject to inspection and approval of the Engineer.

### **732-09 JAR CARTONS**

**SCOPE.** This specification covers the material and fabrication requirements for jar cartons used to contain soil sample jars.

**MATERIAL AND FABRICATION REQUIREMENTS.** Jar cartons shall consist of corrugated Kraft paper cardboard fabricated into a box with overall nominal dimensions of 12 inches wide, 16 inches long

and 7 inches deep. The box shall be partitioned and have sufficient strength to safely support twelve (12) sample jars conforming to 732-08 in a 3 x 4 array.

**BASIS OF ACCEPTANCE.** Jar cartons shall be subject to inspection and approval of the Engineer.

**732-10 BOULDER AND ROCK CORE BOXES**

**SCOPE.** This specification covers the material and fabrication requirements for boxes used to contain core samples of boulders and rock.

**MATERIAL AND FABRICATION REQUIREMENTS.** Boxes shall be fabricated of white pine, Grade No. 2 common or better, 1 inch stock (finished ¾ inch) thickness or an approved equal material and conform to the overall box dimensions given below:

<b>Core Box Size</b>	<b>Length (Inches)</b>	<b>Width (Inches)</b>	<b>Height (Inches)</b>
“AX”	61½	9⅝	2¾
“BX”	61½	10¾	3¼
“NX”	61½	10⅞	3¾
“HX”	61½	11⅞	4⅝

Core rows shall be separated by wooden or tempered hardboard, ⅛ inch thick strips recessed to ⅜ inch depth and glued with waterproof glue at the bottom and ends of the box. Box covers shall be hinged with two, 2 inch steel butt hinges recessed and fastened with flat head wood screws. Box covers shall be secured in a closed position by two 1 1/2 inch hook and eye fasteners. All boxes shall be coated with weatherproof wood preservative. Details are specified on the current Geotechnical Engineering Bureau Drawing entitled “Core Box AX, BX, NX and HX Sizes.”

**BASIS OF ACCEPTANCE.** Core boxes shall be subject to inspection and approval of the Engineer in conjunction with a representative of the Geotechnical Engineering Bureau.

**732-11 OPEN WELL PIEZOMETER**

**SCOPE.** This specification covers the material requirements for open well piezometers.

**MATERIAL REQUIREMENTS.** Monitoring pipe-riser pipe shall be 1 inch (nominal diameter) threaded PVC schedule 40 pipe. Slotted screen pipe shall be 5 feet long and be 1 inch (nominal diameter) threaded PVC schedule 40 pipe. Caps shall be 1 inch (nominal diameter) PVC schedule 40 threaded male cap for the top, and 1 inch (nominal diameter) PVC schedule 40 threaded female cap for the bottom.

**Sand.** Provide well rounded, uniformly graded silica sand, which is correctly sized to the slotted screen. Ottawa sand is acceptable.

**Bentonite pellets.** Provide 1/4 inch (nominal diameter) bentonite pellets.

**Manhole.** Provide a 8 inch (inside diameter) steel flush mount manhole with a 8 inch skirt.

**Cement.** The material shall meet the requirements of '701-01 Portland Cement Type 1 or 2.

**Water.** The water for the mix shall conform to the requirements of '712-01 Water.

**Bentonite Powder.** There are no material requirements for the bentonite, except it shall be supplied in powder form from a reputable manufacturer and pass a No. 200 sieve.

**BASIS OF ACCEPTANCE.** Materials used for the installation of open well piezometers shall be subject to inspection and approval of the Engineer.

### **732-12 GROUT**

**SCOPE.** This specification covers the material requirements for the grouting of bore holes.

#### **MATERIAL REQUIREMENTS.**

**Cement.** The material shall meet the requirements of §701-01 Portland Cement Type 1 or 2.

**Water.** The water for the mix shall conform to the requirements of §712-01 Water.

**Bentonite Powder.** There are no material requirements for the bentonite, except it shall be supplied in powder form from a reputable manufacturer and pass a No. 200 sieve.

**BASIS OF ACCEPTANCE.** The grout shall be subject to inspection and approval of the Engineer.

### **732-13 FOR SITE MANAGER USE**

### **732-99 FOR SITE MANAGER USE**

## **SECTION 733 - EARTHWORK MATERIALS**

(Last Revised May 2019)

### **733-01 FLOWABLE FILL**

**SCOPE.** This specification covers the material requirements and methods of testing flowable fill. The following flowable fill types are evaluated in this specification:

733-0101 – Controlled Low Strength Material (CLSM)

733-0102 – Controlled Low Strength Material (CLSM) (No Fly Ash)

733-0103 – Lightweight Concrete Fill (Type A)

733-0104 – Lightweight Concrete Fill (Type B)

#### **GENERAL.**

**A. Controlled Low Strength Material.** Provide CLSM with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the unconfined compressive strength meets the requirements of the specification. Design the CLSM mix so that it sets within the time stated in the contract documents. If no set time is required, design the set time to meet Contractor's operational requirements.

**B. Lightweight Concrete Fill.** Provide Lightweight Concrete Fill with certified test results supplied by a qualified independent testing laboratory for the mix design verifying the wet cast density and unconfined compressive strength meet the requirements of the specification for the type(s) identified

in the contract documents. Design the Lightweight Concrete Fill utilizing a foaming agent appearing on the Departments Approved List.

## MATERIAL REQUIREMENTS.

### A. Controlled Low Strength Material.

**1. Material.** Provide CLSM containing cement and water. At the Contractor's option, it may also contain fly ash (unless the No Fly Ash item is specified), aggregate, or chemical admixtures in any proportions such that the final product meets the strength and flow consistency requirements included in this specification.

Provide materials meeting the requirements of Table 733-01A *CLSM Material Requirements*:

TABLE 733-01A CLSM MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1 or Type 2	§701-01
Water	§712-01

If used, provide materials meeting Table 733-01B *Requirements for Optional CLSM Material*:

TABLE 733-01B REQUIREMENTS FOR OPTIONAL CLSM MATERIAL	
Material	Subsection
Aggregate Gradation	§703-07 <i>Concrete Sand</i>
Recycled Material	Recycled material approved for use in accordance with §733-19 <i>Recycled Materials Approved for Use as Earthwork Material</i> and as identified in the Approved List.
Chemical Admixtures	Provide admixtures that comply with §711-08 <i>Admixtures</i> . The mix may include high air generators manufactured for CLSM.

**2. Unconfined Compressive Strength.** Provide CLSM with a mix design generating an unconfined compressive strength in Table 733-01C *CLSM Unconfined Compressive Strength*:

TABLE 733-01C CLSM UNCONFINED COMPRESSIVE STRENGTH	
Test Age	Unconfined Compressive Strength
28 days	$40 \text{ psi} \leq q_u \leq 150 \text{ psi}$

### 3. Sampling and Testing.

**i. Spread Diameter.** Provide CLSM that has, at the time of placement, a minimum diameter spread of 8 in. as determined by a Department Representative in accordance with ASTM D6103 *Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)*.

**ii. Cylinder Cast.** A Department Representative will cast three specimens (cylinders) for each batch of CLSM for QA testing. A batch is defined as the amount of material that can be mixed at one time.

## B. Lightweight Concrete Fill.

**1. Material.** Provide materials meeting the requirements of Table 733-01D *Lightweight Concrete Fill Material Requirements*:

TABLE 733-01D LIGHTWEIGHT CONCRETE FILL MATERIAL REQUIREMENTS	
Material	Subsection
Portland Cement, Type 1, 2 of 3	§701-01
Water	§712-01
Admixtures	§711-08
Foaming Agent	See Below

The Foaming Agent shall conform to the requirements of ASTM C 869. Foaming Agents which are on the Approved List shall be accepted at the site on the basis of the brand name labeled on the Foaming Agent container and certified documentation provided by the supplier.

A Foaming Agent not on the Approved List will be evaluated based on submitted information and sample testing by the Materials Bureau (minimum of six months). For each class of material submitted for evaluation, specimens will be required for testing of compressive strength, air-dry density, freeze-thaw and water absorption characteristics, and other testing as deemed appropriate. For detailed information contact the Materials Bureau.

**2. Concrete Fill Types.** Provide lightweight concrete fill conforming to the type(s) specified in the contract documents and meeting the requirements identified in Table 733-01E *Lightweight Concrete Fill Density and Compressive Strength Requirements*.

TABLE 733-01E LIGHTWEIGHT CONCRETE FILL DENSITY AND UNCONFINED COMPRESSIVE STRENGTH REQUIREMENTS		
Type	Maximum Cast Wet Density (pcf)	Minimum Unconfined Compressive Strength – 28 days (psi)
A	30	40
B	42	100

The Contractor shall be responsible for designing the mix so that each type of lightweight concrete fill meets the corresponding criteria listed above. The lightweight concrete fill shall be mixed in accordance with the recommendations of a representative of the supplier of the foaming agent.

### 3. Sampling and Testing.

**i. Density.** A Department Representative will sample and test the wet cast density. After the initial test and approval to proceed, the density will be monitored at 30 minute intervals during placement for QA purposes.

**ii. Cylinder Cast.** A Department Representative will cast four specimens (cylinders) at the point of placement for each day's pour or each 100 yd<sup>3</sup> of material placed, whichever is more frequent, for QA purposes.

## **BASIS OF APPROVAL.**

**A. Controlled Low Strength Material.** Mix designs will be approved based on certified test results supplied by a qualified independent testing laboratory for the unconfined compressive strength in accordance with the specification. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

**B. Lightweight Concrete Fill.** Mix designs will be approved based on (1) certified test results supplied by a qualified independent testing laboratory for the maximum wet cast density and minimum unconfined compressive strength in accordance with the specification, and (2) the brand name labeled on the foaming agent appearing on the Approved List. The methods of installation will be approved based on an evaluation of the equipment's appropriateness with respect to the site conditions.

## **BASIS OF ACCEPTANCE.**

**A. Controlled Low Strength Material.** CLSM material will be accepted on the jobsite upon submission of certified test results of the mix design to the Engineer. CLSM material will be accepted after employment of the approved method of installation and upon acceptable test results for spread diameter and unconfined compressive strength.

**B. Lightweight Concrete Fill.** Lightweight Concrete Fill material will be accepted on the jobsite upon submission of a certified mix design to the Engineer and confirmation that the brand name labeled on the foaming agent appears on the Approved List. Lightweight Concrete Fill material will be accepted after employment of the approved method of installation and upon acceptable test results for density and unconfined compressive strength.

## **733-02 MECHANICALLY STABILIZED EARTH SYSTEM BACKFILL MATERIAL**

**SCOPE.** This specification covers the material requirements and methods of testing backfill material generally used for the construction of a MSES.

**SAMPLING.** Perform material tests and assurance methods pertaining to the backfill requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) "*Procedure for the Control and Quality Assurance of Granular Materials*".

**GENERAL.** Provide backfill material for any MSES from a single source unless prior approval for use of designated multiple sources is obtained from the Director, GEB.

## **MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile the backfill material in accordance with the Geotechnical Control Procedure (GCP-17) "*Procedure for the Control and Quality Assurance of Granular Materials*".

**B. GRADATION.** Provide backfill material of one of the following types:

**I. Type A.** Material consisting of any mineral (inorganic) soil, blasted or broken rock, or similar materials of natural origin, including mixtures thereof, and having a gradation in accordance with TABLE 733-02A *Backfill Gradation*.

TABLE 733-02A BACKFILL GRADATION	
Sieve Size Designation	Percentage Passing by Weight
4 in.	100
¼ in.	30-100
No. 40	0-60
No. 200	0-15

**2. Type B.** Material consisting of crushed stone conforming to §703-02 *Coarse Aggregate*, Size Designation 2 with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%. Type B material shall be covered with a geotextile separator to deter the migration of fines. A geotextile separator conforming to the requirements of §737-01 (B) *Geotextile Separation* is required on the top and all sides (with the exception of the wall interface) of the Type B material. No separate measurement for payment of the geotextile shall be made.

**C. PLASTICITY INDEX.** Provide material having a Plasticity Index not exceeding 5.

**D. DURABILITY.** Provide material having a Magnesium Sulfate Soundness loss less than 30% after four (4) cycles tested in accordance with the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**E. CORROSION POTENTIAL (METAL REINFORCING AND/OR CONNECTORS ONLY).** The Department will test for the corrosion potential of any system with exposed metal in the backfill. Stockpiled materials will be tested for resistivity and pH, and may be tested for sulfides at the Department's discretion. Material failing to meet the following requirements of Table 733-02B *Resistivity, Soluble Salts and pH Requirements*, will be rejected except as specified below:

Material failing to meet the resistivity criterion may be tested for sulfate and chlorides. Material meeting the criteria for both sulfates and chlorides and having a resistivity greater than 10 ohm-m will be acceptable. Chemical testing (i.e. resistivity, sulfate ion content, sulfide ion content, and chloride ion content) is not required for Type B backfill.

TABLE 733-02B RESISTIVITY, SOLUBLE SALTS AND pH REQUIREMENTS			
Property		Test Method	Acceptance Criteria
Resistivity		AASHTO T288	$\rho \geq 30$ ohm-m
Chlorides		AASHTO T291 Method A	$Cl^- \leq 100$ mg/kg
Sulfates		AASHTO T290 Method A, gravimetric	$SO_4^{2-} \leq 200$ mg/kg
		AASHTO T290 Method B, turbidmetric	
Sulfides		NYSDOT Test Method 711-12C	$S^{2-} \leq 300$ mg/kg
pH	Type A	NYSDOT GTM-24	$5 \leq pH \leq 10$
	Type B	NYSDOT GTM-24	$5 \leq pH \leq 12.5$

**BASIS OF APPROVAL.** Stockpiles of MSES backfill material will be approved by the GEB in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*” and the procedural directives of the GEB.

**BASIS OF ACCEPTANCE.** Backfill material from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Backfill material from approved stockpiles will be accepted as part of the MSES upon confirmation that the material gradation type provided by the Contractor, outlined in §733-02B *Gradation*, conforms to the MSES submittal provided by the wall system designer-supplier and upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. In addition to the requirements of Section 106 *Control of Material*, the Department will sample and test backfill taken from behind the newly-constructed wall to assure quality. The number of samples and their locations (plan and elevation) will be determined based on the quantity of material to be used in each MSES structure in accordance with the Geotechnical Control Procedure (GCP-20) “*Procedure for Taking Random Samples of Backfill Material for Mechanically Stabilized Earth Systems*”. Results from chemical testing (i.e. resistivity, sulfate ion content, sulfide ion content, and chloride ion content) can take several weeks to obtain.

**733-03 GEOSYNTHETICALLY REINFORCED SOIL SYSTEM SLOPE BACKFILL MATERIAL**

**SCOPE.** This specification covers the material requirements and methods of testing backfill material generally used for the construction of over steepened slopes utilizing Geosynthetically Reinforced Soil System (GRSS).

**SAMPLING.** Obtain a representative sample of the source for the performance of a gradation analysis in accordance with the procedures contained in the Geotechnical Test Method (GTM-20) “*Test Method for the Grain- Size Analysis of Granular Soil Materials*”.

**MATERIAL REQUIREMENTS.**

**A. COMPOSITION.** Any mineral (inorganic) soil, blasted or broken rock, or similar materials of natural origin, including mixtures thereof, are suitable materials.

**B. GRADATION.** Provide backfill material conforming to the following:

**1. Gradation Spread.** Provide backfill material having a gradation in accordance with TABLE 733-03A *Backfill Gradation*.

TABLE 733-03A BACKFILL GRADATION	
Sieve Size Designation	Percentage Passing by Weight
6 in.	100
No. 40	0-60
No. 200	0-40

**2. Gradation Ratio.** Provide backfill material having a gradation ratio in accordance with the following formula:

$$\frac{\text{Percent Pass. No.200 sieve}}{\text{Percent Pass. No.40 sieve}} \times 100 \leq 70$$



The gradation is evaluated at the contract level.

**BASIS OF APPROVAL.** Material will be approved upon successful completion of the gradation tests indicating that the material conforms to the specification.

**BASIS OF ACCEPTANCE.** Backfill material will be accepted based upon successful completion of the gradation tests indicating that the material conforms to the specification.

### **733-04 SUBBASE COURSE**

**SCOPE.** This specification covers the material requirements and methods of testing subbase material generally used in the construction of a pavement structure. The following subbase types are evaluated in this specification:

- 733-0401 – Subbase Course, Type 1
- 733-0402 – Subbase Course, Type 2
- 733-0403 – Subbase Course, Type 3
- 733-0404 – Subbase Course, Type 4

Subbase course types are based on the gradation of the material as outlined in Table 733-04A *Subbase Gradation*.

**SAMPLING.** Perform material tests and assurance methods pertaining to subbase requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**GENERAL.** Provide suitable material conforming to the requirements of Section 203 *Excavation and Embankment* and to the requirements contained herein.

### **MATERIAL REQUIREMENTS.**

**A. COMPOSITION.** For Types 1, 3 and 4 furnish materials consisting of Stone, Sand, Gravel, and/or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List), or blends of these materials.

For Type 2, furnish materials consisting of Stone, or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List), which is the product of crushing or blasting ledge rock, or a blend of approved recycled material and Stone.

**B. STOCKPILE.** Stockpile subbase material in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*” except as noted herein.

**1. Type 3.** Material furnished under Type 3 will not be required to be stockpiled unless it contains recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* and as identified in the Approved List.

**2. Recycled Materials.** Stockpiling of the Reclaimed Asphalt Pavement (RAP) for subbase course is not required.

**C. GRADATION.** Provide subbase material having a gradation in accordance with TABLE 733-04A *Subbase Gradation*.

TABLE 733-04A SUBBASE GRADATION				
Sieve Size Designation	Percentage Passing by Weight			
	Type 1	Type 2	Type 3	Type 4
4 in.	-	-	100	-
3 in.	100	-	-	-
2 in.	90-100	100	-	100
¼ in.	30-65	25-60	30-75	30-65
No. 40	5-40	5-40	5-40	5-40
No. 200	0-10	0-10	0-10	0-10

**D. PLASTICITY INDEX.** Provide material having a Plasticity Index based on the material passing the No. 40 mesh sieve equal to or less than 5.0.

**E. DURABILITY.**

**1. Types 1, 2 and 4.** Provide material for Types 1, 2 and 4 having a Magnesium Sulfate Soundness loss less than 20% after four (4) cycles tested in accordance with the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”, unless material meeting the requirements of Recycled Materials is used.

**2. Type 3.** Provide material for Type 3 having a Magnesium Sulfate Soundness loss less than 30% after four (4) cycles tested in accordance with the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**F. ELONGATED PARTICLES.** A flat or elongated particle is defined herein as one which has its greatest dimension more than three (3) times its least dimension. Provide material consisting of particles where not more than 30%, by weight, of the particles retained on a ½ in. sieve is flat or elongated. When the State elects to test for this requirement, material with a percentage greater than 30 will be rejected. Acceptance for this requirement will normally be based on a visual inspection by the Regional Geotechnical Engineer.

**G. MATERIAL FOR TEMPORARY WORK.** Material used as a subbase for the construction of temporary work may be approved by a Departmental Geotechnical Engineer by visual inspection in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”. Do not permanently incorporate material so approved into the work without following the appropriate acceptance procedure.

**BASIS OF APPROVAL.** Stockpiles of subbase material will be approved in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**BASIS OF ACCEPTANCE.** Subbase material from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Subbase material from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, subbase material will be accepted upon the basis of the stockpile approval.

### **733-05 GLASS BACKFILL**

**SCOPE.** This specification covers the material requirements and methods of assessing glass backfill material generally used as fill material.

**SAMPLING.** Perform material tests and assurance methods pertaining to the glass backfill requirements in conformance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

#### **MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile glass backfill material in accordance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Waste glass cullet ground up to be used as aggregate.

**C. GRADATION.** Provide glass crushed to a maximum particle size of  $\frac{3}{8}$  in. The material shall be subject to visual inspection by the Regional Geotechnical Engineer.

**D. CHARACTERISTICS.** Glass may contain up to a maximum of 5% by volume of china, ceramics, plate glass products, paper, plastics or other deleterious materials.

**BASIS OF APPROVAL.** Glass backfill will be approved in accordance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

The material shall be subject to visual inspection by the Regional Geotechnical Engineer.

**BASIS OF ACCEPTANCE.** Glass backfill from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Approved glass backfill material will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, glass backfill material will be accepted upon the basis of the stockpile approval.

### **733-06 RECLAIMED ASPHALT PAVEMENT FOR EARTHWORK AND SUBBASE**

**SCOPE.** This specification covers the material requirements and methods of assessing Reclaimed Asphalt Pavement (RAP) generally used as fill material.

**SAMPLING.** Perform material tests and assurance methods pertaining to the RAP requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

#### **MATERIAL REQUIREMENTS.**

**A. SOURCE.** Provide written documentation that the reclaimed bituminous material originated on a Department project. Include an identifier, such as State Highway number, construction contract number or Department Project Identification Number (PIN).

**B. COMPOSITION.** Millings of asphalt cement concrete.

**C. GRADATION.**

*1. Gradation Spread.* Provide RAP having a maximum top size of 2 in. at the time of placement.

*2. Elongated Particles.* A flat or elongated particle is defined herein as one which has its greatest dimension more than three (3) times its least dimension. Provide material consisting of particles where not more than 30%, by weight, of the particles retained on a ½ in. sieve are flat or elongated. When the State elects to test for this requirement, material with a percentage greater than 30 will be rejected. Acceptance for this requirement will normally be based on a visual inspection by the Regional Geotechnical Engineer.

**D. CHARACTERISTICS.** Bituminous material that is well-graded from coarse to fine and free from organic or other deleterious material, including tar. This material is at least 95%, by weight, reclaimed bituminous material. No soundness or Plasticity Index testing will be required.

**BASIS OF APPROVAL.** RAP will be approved based upon a visual inspection by the Regional Geotechnical Engineer.

**BASIS OF ACCEPTANCE.** Approved RAP will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, RAP will be accepted upon the basis of the visual inspection by the Regional Geotechnical Engineer.

### **733-07 RECYCLED PORTLAND CEMENT CONCRETE AGGREGATE**

**SCOPE.** This specification covers the material requirements and methods of testing Recycled Portland Cement Concrete Aggregate (RCA) generally used as fill material. The following RCA types are evaluated in this specification:

733-0701 – Recycled Portland Cement Concrete Aggregate

733-0702 – Recycled Portland Cement Concrete Aggregate Mixture

**SAMPLING.** Perform material tests and assurance methods pertaining to the RCA requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

### **MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile RCA in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Crushed portland cement concrete.

If RCA comes from other than a Department project, provide documentation showing that the material obtained is from a NYSDEC registered or permitted construction and demolition (C&D) debris processing facility as specified in Section 360-16.1 of 6NYCRR Part 360, "Solid Waste Management Facilities".

### C. GRADATION.

**1. Gradation Spread.** Provide RCA meeting the gradation requirements for the appropriate item of use.

**2. Elongated Particles.** A flat or elongated particle is defined herein as one which has its greatest dimension more than three (3) times its least dimension. Provide material consisting of particles where not more than 30%, by weight, of the particles retained on a ½ in. sieve are flat or elongated. When the State elects to test for this requirement, material with a percentage greater than 30 will be rejected. Acceptance for this requirement will normally be based on a visual inspection by the Regional Geotechnical Engineer.

### D. CHARACTERISTICS.

**1. Alternate A.** At least 95%, by weight, of Recycled Portland Cement Concrete Aggregate (RCA), and free from organic and other deleterious material. This material may contain up to 5% by weight asphalt and/or brick.

**2. Alternate B.** A mixture of Recycled Portland Cement Concrete Aggregate (RCA) conforming to Alternate A above mixed with stone, sand, gravel or blast furnace slag. This material may contain up to 5% by weight asphalt and/or brick.

**BASIS OF APPROVAL.** Stockpiles of RCA will be approved in accordance with the Geotechnical Control Procedure (GCP-17) "*Procedure for the Control and Quality Assurance of Granular Materials*".

**BASIS OF ACCEPTANCE.** RCA from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

RCA from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, RCA will be accepted upon the basis of the stockpile approval.

### 733-08 EMBANKMENT IN PLACE

**SCOPE.** This specification covers the material requirements and methods of assessing material generally used for embankment construction and for general fill applications independent of a roadway embankment.

### MATERIAL REQUIREMENTS.

**A. COMPOSITION.** In general, any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man made (i.e. recycled) origin, including mixtures thereof, are considered suitable materials. Recycled materials are approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* and are identified in the Approved List.

**B. GRADATION.** Provide suitable embankment material having no particles with a dimension in excess of two-thirds of the loose lift thickness controlled by the compaction equipment supplied by the Contractor. When material is placed independent of a roadway embankment, the material shall have a gradation and material properties acceptable to the Engineer.

**BASIS OF ACCEPTANCE.** Embankment material will be accepted upon visual inspection by the Engineer.

### 733-09 SELECT BORROW

**SCOPE.** This specification covers the material requirements and methods of testing select borrow material generally used for backfilling in areas beneath the watertable.

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures for non-stockpiled materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

### MATERIAL REQUIREMENTS.

**A. SOURCE.** Provide backfill material from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide suitable, well graded material consisting of rock, stone, cobbles, or gravel, or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide select borrow material having no particles greater than 3 ft. in maximum dimension. Of the portion passing the 4 in. square sieve, the material shall have a gradation in accordance with TABLE 733-09A *Select Borrow Gradation*.

TABLE 733-09A SELECT BORROW GRADATION	
Sieve Size Designation	Percentage Passing by Weight
No. 40	0-70
No. 200	0-15

The gradation is evaluated at the project level.

**D. DURABILITY.** Provide material having a Magnesium Sulfate Soundness loss less than 35% after four (4) cycles tested in accordance with the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**BASIS OF APPROVAL.** Material will be approved in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

A preceding source evaluation will be valid for the time identified in the manual. For sources without a current evaluation, samples shall be obtained under the direction of the Departmental Geotechnical Engineer and will be tested and evaluated by the Geotechnical Engineering Bureau.

**BASIS OF ACCEPTANCE.** Approved select borrow backfill material from evaluated sources will be accepted upon successful completion of the gradation tests and Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, approved select borrow material will be accepted upon successful completion of the gradation tests.

### **733-10 SELECT FILL**

**SCOPE.** This specification covers the material requirements and methods of testing select fill material generally used for backfilling in areas beneath the watertable or within water bodies.

**SAMPLING.** The sampling procedure contained in §733-09 *Select Borrow* shall apply.

**MATERIAL REQUIREMENTS.** The material requirements contained in §733-09 *Select Borrow* shall apply.

**BASIS OF APPROVAL.** The basis of approval contained in §733-09 *Select Borrow* shall apply.

**BASIS OF ACCEPTANCE.** The basis of acceptance contained in §733-09 *Select Borrow* shall apply.

### **733-11 SELECT GRANULAR FILL**

**SCOPE.** This specification covers the material requirements and methods of testing select granular fill material generally used for backfilling around pipes. The following materials are evaluated in this specification:

733-1101 – Select Granular Fill (Typical)

733-1102 – Select Granular Fill for Corrugated Aluminum Pipe

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures for non-stockpiled materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

#### **MATERIAL REQUIREMENTS.**

**A. SOURCE.** Provide backfill material from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide suitable, well graded material consisting of rock, stone, cobbles, or gravel, or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List) with the exception of when select granular fill is used as backfill for aluminum pipe. For aluminum pipe applications, the select granular fill shall be free of portland cement or portland cement concrete.

**C. GRADATION.** Provide select granular fill material conforming to the following requirements:

**1. Typical.** Except when used as backfill material for aluminum pipe with Type IR corrugations (Spiral Rib Pipe), the material shall have a gradation in accordance with TABLE 733-11A *Select Granular Fill Gradation*.

TABLE 733-11A SELECT GRANULAR FILL GRADATION	
Sieve Size Designation	Percentage Passing by Weight
4 in.	100
No. 40	0-70
No. 200	0-15

**2. Exception.** When used as backfill for Corrugated Aluminum Pipe, Type 1R (Spiral Rib Pipe) 100% of the material shall also pass the 2 in. sieve.

The gradation is evaluated at the project level.

**D. DURABILITY.** Provide material having a Magnesium Sulfate Soundness loss less than 30% after four (4) cycles tested in accordance with the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**E. pH.** Where the State elects to test for this requirement, the material shall have a pH in accordance with TABLE 733-11B *Select Granular Fill pH Requirement*.

TABLE 733-11B SELECT GRANULAR FILL pH REQUIREMENT		
Property	Test Method	Acceptance Criteria
<i>pH</i>	NYSDOT GTM-24	$5 \leq pH \leq 10$

When RCA is used as backfill in a non-aluminum pipe application, the pH requirements are waived.

**BASIS OF APPROVAL.** Material will be approved in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

A preceding source evaluation will be valid for the time identified in the manual. For sources without a current evaluation, samples shall be obtained under the direction of the Departmental Geotechnical Engineer and will be tested and evaluated by the Geotechnical Engineering Bureau.

**BASIS OF ACCEPTANCE.** Approved select granular fill backfill material from evaluated sources will be accepted upon successful completion of the gradation tests and Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, approved select granular fill backfill material will be accepted upon successful completion of the gradation tests.

### 733-12 SELECT GRANULAR FILL SLOPE PROTECTION

**SCOPE.** This specification covers the material requirements and methods of testing select granular fill slope protection material generally used for stabilizing sloughing slopes. The following materials are evaluated in this specification:

- 733-1201 – Select Granular Fill Slope Protection (Blasted Rock)
- 733-1202 – Select Granular Fill Slope Protection (Typical)

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures for non-stockpiled materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.



## MATERIAL REQUIREMENTS.

**A. SOURCE.** Provide backfill material from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide material consisting of rock, stone, cobbles, or gravel, or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide select granular slope protection material conforming to the following requirements:

1. Broken or blasted unweathered rock used for this item shall be well graded, having no particles greater than 24 in. in maximum dimension, and be substantially free from particles greater than 12 in. in maximum dimension, containing little or no material passing the No. 10 mesh sieve.
2. All materials, other than broken or blasted unweathered rock, shall have a gradation in accordance with TABLE 733-12A *Select Granular Fill Slope Protection Gradation*.

TABLE 733-12A SELECT GRANULAR FILL SLOPE PROTECTION GRADATION	
Sieve Size Designation	Percentage Passing by Weight
24 in. maximum dimension	100
6 in. maximum dimension	90-100
2 in. square sieve	0-30
¼ in. sieve	0-10

The gradation is evaluated at the project level.

**D. DURABILITY.** Provide material having a Magnesium Sulfate Soundness loss less than 35% after four (4) cycles tested in accordance with Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**BASIS OF APPROVAL.** Material will be approved in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

A preceding source evaluation will be valid for the time identified in the manual. For sources without a current evaluation, samples shall be obtained under the direction of the Departmental Geotechnical Engineer and will be tested and evaluated by the Geotechnical Engineering Bureau.

**BASIS OF ACCEPTANCE.** Approved select granular fill slope protection backfill material from evaluated sources will be accepted upon successful completion of the gradation tests and Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, approved select granular fill slope protection backfill material will be accepted upon successful completion of the gradation tests.

### 733-13 SELECT GRANULAR SUBGRADE

**SCOPE.** This specification covers the material requirements and methods of testing select granular subgrade material generally used for backfilling undercuts. The following materials are evaluated in this specification:

- 733-1301 – Select Granular Subgrade (Blasted Rock)
- 733-1302 – Select Granular Subgrade (Typical)
- 733-1303 – Select Granular Subgrade (RCA)
- 733-1304 – Select Granular Subgrade (RCA Mixture)
- 733-1305 – Select Granular Subgrade (RAP)

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures for non-stockpiled materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**MATERIAL REQUIREMENTS.**

**A. SOURCE.** Provide backfill material from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide material consisting of rock, stone, cobbles, or gravel, or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide select granular subgrade material conforming to the following requirements:

1. Well graded rock may be used for this item. Particles shall not exceed 12 in. in greatest dimension nor  $\frac{2}{3}$  of the loose lift thickness, whichever is less.
2. All materials, other than well graded rock, furnished under this item shall have no particles greater than 6 in. in maximum dimension. Of the portion passing the 4 in. square sieve, the material shall have a gradation in accordance with TABLE 733-13A *Select Granular Subgrade Gradation*.

TABLE 733-13A SELECT GRANULAR SUBGRADE GRADATION	
Sieve Size Designation	Percentage Passing by Weight
¼ in.	30-100
No. 40	0-50
No. 200	0-10

The gradation is evaluated at the project level.

**D. DURABILITY.** Provide material having a Magnesium Sulfate Soundness loss less than 35% after four (4) cycles tested in accordance with Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**BASIS OF APPROVAL.** Material will be approved in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

A preceding source evaluation will be valid for the time identified in the manual. For sources without a current evaluation, samples shall be obtained under the direction of the Departmental Geotechnical Engineer and will be tested and evaluated by the Geotechnical Engineering Bureau.

**BASIS OF ACCEPTANCE.** Approved select granular subgrade backfill material from evaluated sources will be accepted upon successful completion of the gradation tests and Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, approved select granular subgrade backfill material will be accepted upon successful completion of the gradation tests.

### **733-14 SELECT STRUCTURE FILL**

**SCOPE.** This specification covers the material requirements and methods of testing select granular fill material generally used for backfilling behind structures.

**SAMPLING.** The sampling procedure contained in §733-11 *Select Granular Fill* shall apply.

**MATERIAL REQUIREMENTS.** The material requirements contained in §733-11 *Select Granular Fill* shall apply.

**BASIS OF APPROVAL.** The basis of approval contained in §733-11 *Select Granular Fill* shall apply.

**BASIS OF ACCEPTANCE.** The basis of acceptance contained in §733-11 *Select Granular Fill* shall apply.

### **733-15 SAND BACKFILL**

**SCOPE.** This specification covers the material requirements and methods of testing sand backfill generally used for backfilling around utilities.

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures for non-stockpiled materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

#### **MATERIAL REQUIREMENTS.**

**A. SOURCE.** Provide backfill material from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide material consisting of sand.

**C. GRADATION.** Provide sand backfill material having a gradation in accordance with TABLE 733-15A *Sand Backfill Gradation*.

TABLE 733-15A SAND BACKFILL GRADATION	
Sieve Size Designation	Percentage Passing by Weight
½ in.	100
¼ in.	90-100
No. 200	0-5

The gradation is evaluated at the project level.

**D. pH.** Where the State elects to test for this requirement, the material shall have a pH in accordance with TABLE 733-15B *Sand Backfill pH Requirement*.

TABLE 733-15B SAND BACKFILL pH REQUIREMENT		
Property	Test Method	Acceptance Criteria
<i>pH</i>	NYSDOT GTM-24	$5 \leq pH \leq 10$

**BASIS OF APPROVAL.** Sources will be evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

A preceding source evaluation will be valid for the time identified in the manual. For sources without a current evaluation, samples shall be obtained under the direction of the Departmental Geotechnical Engineer and will be tested and evaluated by the Geotechnical Engineering Bureau.

**BASIS OF ACCEPTANCE.** Approved sand backfill material from approved sources will be accepted upon successful completion of the gradation tests and Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, approved sand backfill material will be accepted upon successful completion of the gradation tests.

### 733-16 WINTER EARTHWORK

**SCOPE.** This specification addresses the material requirements and methods of assessing earthwork materials placed during construction operations between November 1st and April 1st. The following materials are evaluated in this specification:

- 733-1601 – Winter Earthwork Material for Embankment In Place
- 733-1602 – Winter Earthwork Material for Select Borrow
- 733-1603 – Winter Earthwork Material for Select Fill
- 733-160401 – Winter Earthwork Material for Select Granular Fill (Typical)
- 733-160402 – Winter Earthwork Material for Select Granular Fill for Corrugated Aluminum Pipe
- 733-160501 – Winter Earthwork Material for Select Granular Subgrade (Blasted Rock)
- 733-160502 – Winter Earthwork Material for Select Granular Subgrade (Typical)
- 733-160503 – Winter Earthwork Material for Select Granular Subgrade (RCA)
- 733-160504 – Winter Earthwork Material for Select Granular Subgrade (RCA Mixture)
- 733-1606 – Winter Earthwork Material for Select Structural Fill
- 733-1607 – Winter Earthwork Material for GRSS Slope Backfill
- 733-1608 – Winter Earthwork Material for MSES Backfill

**SAMPLING.** Perform material tests and quality assurance methods pertaining to the backfill requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

## **MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile all winter earthwork material in accordance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**B. COMPOSITION.** Provide material consisting of crushed stone, crushed gravel, or screened gravel.

### **C. GRADATION.**

**1. Winter Earthwork Material for Embankment In Place.** Provide winter earthwork material conforming to the requirements of §703-02 *Coarse Aggregate*, with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%. The Contractor shall specify the Size Designation as part of the Winter Earthwork submittal in accordance with §203-3.01 A. *Winter Earthwork Submittal*.

**Alternate Source.** Blasted rock from on-site rock excavation may be used provided it is detailed in, and approved as part of, the Winter Earthwork submittal in accordance with §203-3.01 A. *Winter Earthwork Submittal*.

**2. Winter Earthwork Material for Select Borrow, Winter Earthwork Material for Select Fill, Winter Earthwork Material for Select Granular Fill, Winter Earthwork Material for Select Granular Subgrade, Winter Earthwork Material for Select Structure Fill, Winter Earthwork Material for GRSS Slope Backfill.** Provide winter earthwork material conforming to the requirements of §703-02 *Coarse Aggregate*, with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%. The Contractor shall specify the Size Designation as part of the Winter Earthwork submittal in accordance with §203-3.01 A. *Winter Earthwork Submittal*.

**3. Winter Earthwork Material for MSES Backfill.** Provide winter earthwork material conforming to the requirements of §733-02 Type B.

### **C. CHARACTERISTICS.**

**1.** No frozen material is to be incorporated into or be allowed to remain in any of the work.

**2.** In locations where winter earthwork material has been placed to completely, or partially, fill the delineated backfill area and the situation allows the Contractor to revert back to standard backfill material, the winter earthwork material shall be covered with a geotextile separator to deter the migration of fines. A geotextile separator conforming to the requirements of §737-01 (B) *Geotextile Separation* is required on the top and all sides of the winter earthwork material. No separate measurement for payment of the geotextile shall be made.

**BASIS OF APPROVAL.** Stockpiles of winter earthwork material will be evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**BASIS OF ACCEPTANCE.** Winter Earthwork material from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name,

Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Winter Earthwork material from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, Winter Earthwork material will be accepted upon the basis of the stockpile approval.

Winter Earthwork Material for MSES Backfill from approved stockpiles will be accepted as part of the MSES upon confirmation that the material gradation type provided by the Contractor, outlined in §733-02B *Gradation*, conforms to the MSES submittal provided by the wall system designer-supplier and upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. In addition to the requirements of Section 106 *Control of Material*, the Department will sample and test backfill taken from behind the newly-constructed wall to assure quality. The number of samples and their locations (plan and elevation) will be determined by the quantity of material to be used in each MSES structure. Results from chemical testing (i.e. resistivity, sulfate ion content, sulfide ion content, and chloride ion content) can take several weeks to obtain.

### **733-17 SURFACE SETTLEMENT GAUGE**

**SCOPE.** This specification covers the material requirements and methods of installation of the embankment construction control device surface settlement gauge generally used for monitoring embankment construction. The following materials are evaluated in this specification:

- 733-1701 – Surface Settlement Gauge (Pipe Gauge)
- 733-1702 – Surface Settlement Gauge (Manometer Gauge)

**MATERIAL REQUIREMENTS.** Provide material in conformance with the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*” including:

#### **A. PIPE GAUGE.**

**1. Pipe.** Provide a minimum 2 ½ in. diameter metal pipe with steel flange meeting the requirements of §732-02 *Drive Pipe*. Provide a sufficient amount of pipe extensions to meet the rise requirements identified in the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*”.

**2. Base.** Provide either of the following:

**a. Steel.** Provide a minimum ¼ in. thick steel plate meeting the requirements of §715-01 *Structural Steel*.

**b. Wood.** Provide wood to the sizes shown in the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*” conforming to the requirements of §712-14 *Stress Graded Timber and Lumber*. Treat wood in accordance with §708-31 *Wood Preservative - Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

**B. MANOMETER GAUGE.** Provide materials specified for A. *Pipe Gauge* with the exception of the pipe extensions. To obtain readings from the buried device, provide the following connection:

**1. Interconnection.**

**a. Tubing.** Provide ½ in. O.D. polyethylene tubing indicated in the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*”.

**b. Sand.** Provide sand conforming to the requirement of §703-07 *Concrete Sand*.

**c. Fluid.** Provide a 50-50 mixture of ethylene glycol and water.

**2. Readout Box.** Provide wood to the sizes shown in the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*” conforming to the requirements of §712-14 *Stress Graded Timber and Lumber*. Treat wood in accordance with §708-31 *Wood Preservative - Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

**3. Base.** Provide wood to the sizes shown in the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*” conforming to the requirements of §712-14 *Stress Graded Timber and Lumber*. Treat wood in accordance with §708-31 *Wood Preservative - Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

**BASIS OF APPROVAL.** The material shall be approved on the basis of manufacturer’s certification that the material conforms to the specification.

**BASIS OF ACCEPTANCE.** Approved material will be accepted upon successful assemblage and installation in accordance with the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*”.

**733-18 SETTLEMENT ROD**

**SCOPE.** This specification covers the material requirements and methods of installation of the embankment construction control device settlement rod generally used for monitoring embankment construction.

**MATERIAL REQUIREMENTS.** Provide material in conformance with the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*” including:

**A. ROD.** Provide a minimum ½ in. diameter steel rod meeting the requirements of §709-01 *Bar Reinforcement, Grade 60*.

**B. PIPE.** Provide a minimum 3 in. diameter metal pipe and cap meeting the requirements of §732- 02 *Drive Pipe*.

**BASIS OF APPROVAL.** The material shall be approved on the basis of manufacturer’s certification that the material conforms to the specification.

**BASIS OF ACCEPTANCE.** Approved material will be accepted upon successful assemblage and installation in accordance with the Geotechnical Control Procedure (GCP-15) “*Settlement Gauges and Settlement Rods*”.

## 733-19 RECYCLED MATERIALS APPROVED FOR USE AS EARTHWORK MATERIAL

**SCOPE.** This specification covers the methods of assessing recycled materials for use as substitutions to, or blends with, earthwork material.

**SAMPLING.** Perform material tests and assurance methods pertaining to recycled material requirements in conformance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

### MATERIAL REQUIREMENTS.

**A. STOCKPILE.** Stockpile recycled material in accordance with the procedures for stockpiled granular materials contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**1. Recycled Materials.** Stockpiling of the Reclaimed Asphalt Pavement (RAP) is not required. RAP will be approved based upon a visual inspection of the storage pile by the Regional Geotechnical Engineer.

**B. GRADATION.** Provide recycled material meeting the gradation requirements for the appropriate item of use.

**BASIS OF APPROVAL.** To be considered suitable for highway use, a recycled material must consistently satisfy specification requirements. The approval criterion for recycled material includes:

1. Material must meet applicable FHWA, EPA and NYSDEC regulations. A Beneficial Use Determination (BUD) from NYSDEC is required.
2. Material shall be sound engineering materials such that when used alone, or in conjunction with other materials, shall provide durable, predictable performance results.
3. The use of the recycled material shall be uncontaminated and shall not pose any hazards. (i.e. potential hazard or danger to workers and /or equipment during construction). Safety procedures will be reviewed.
4. Evaluation of each use of recycled materials will be based on existing quality and performance standards.
5. Life-cycle costs shall be equivalent, or less than, those from the use of standard construction materials.

Recycled materials approved for use as Earthwork Materials will be added to the Approved List.

**BASIS OF ACCEPTANCE.** Recycled material will be accepted on the basis of:

1. The recycled material name appearing on the Approved List for the intended application,
2. The recycled material from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.
3. Approved recycled material will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, recycled material will be accepted upon the basis of the stockpile approval.

## 733-20 UNDERDRAIN FILTER MATERIAL



**SCOPE.** This specification covers the material requirements and methods of testing underdrain filter material generally used in drainage systems. The following underdrain filter types are evaluated in this specification:

- 733-2001 – Underdrain Filter, Type 1
- 733-2002 – Underdrain Filter, Type 2
- 733-2003 – Underdrain Filter, Type 3

Underdrain filter types are based on the gradation of the material as outlined in Table 733-20A *Underdrain Filter Material Gradation*.

**SAMPLING.** Perform material tests and assurance methods pertaining to underdrain filter material requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile underdrain filter material in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*” except as noted herein.

**B. COMPOSITION.** Provide material consisting crushed stone, sand, gravel, or screened gravel or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide underdrain filter material having a gradation in accordance with TABLE 733-20A *Underdrain Filter Material Gradation*.

<b>TABLE 733-20A UNDERDRAIN FILTER MATERIAL GRADATION</b>			
<b>Sieve Size Designation</b>	<b>Percentage Passing by Weight</b>		
	<b>Type 1</b>	<b>Type 2</b>	<b>Type 3</b>
1 in.	100	-	-
½ in.	30-100	100	-
¼ in.	0-30	20-100	100
No. 10	0-10	0-15	70-100
No. 20	0-5	0-5	30-70
No. 40	-	-	20-50
No. 200	-	-	0-5

**D. DURABILITY.** Provide material meeting the soundness requirements of §703-02 *Coarse Aggregates* for Type 1 and Type 2. Provide material meeting the soundness requirements of §703-01 *Fine Aggregates* for Type 3. When electing to use material from sources not approved under §703-02, provide material having a Magnesium Sulfate Soundness loss less than 20% in conformance with the procedures contained in the Geotechnical Test Method (GTM-21) “*Test Method for Magnesium Sulfate Soundness of Granular Materials*”.

**E. CHARACTERISTICS.** In locations where Underdrain Filter Material Type 3 is used to directly surround a perforated underdrain pipe, the perforated underdrain pipe shall be wrapped with a geotextile conforming to the requirements of §737-01 (C) *Geotextile Drainage*. No separate measurement for payment of the geotextile shall be made.

**BASIS OF APPROVAL.** Stockpiles of underdrain filter material will be evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “*Procedure for the Control and Quality Assurance of Granular Materials*”.

**BASIS OF ACCEPTANCE.** Underdrain filter material from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Underdrain filter material from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, underdrain filter material will be accepted upon the basis of the stockpile approval.

**733-21 STONE FILLING**

**SCOPE.** This specification covers the material requirements and methods of testing stone filling generally used in stream bank channel protection. The following stone filling types are evaluated in this specification:

- 733-2101 – Stone Filling, Fine
- 733-2102 – Stone Filling, Light
- 733-2103 – Stone Filling, Medium
- 733-2104 – Stone Filling, Heavy
- 733-2108 – Stone Filling, Check Dam

Stone filling types are based on the gradation of the material as outlined in Table 733-21A *Stone Filling Gradation* and Table 733-21B *Stone Filling Approximate Shape*.

**SAMPLING.** Perform material tests and assurance methods pertaining to stone filling requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

**MATERIAL REQUIREMENTS.**

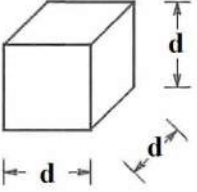
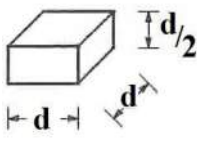
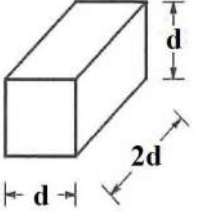
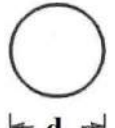
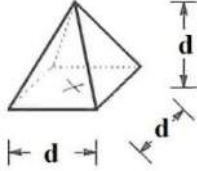
**A. STOCKPILE.** Stockpile stone filling in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*” except as noted herein.

**B. COMPOSITION.** Provide material consisting blasted or broken unweathered rock or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide stone fill material having a gradation in accordance with TABLE 733-21A *Stone Filling Gradation* and Table 733-21B *Stone Filling Approximate Shape*.

TABLE 733-21A STONE FILLING GRADATION			
Stone Filling Item	See Notes	Stone Size	Percent of Total by Weight
Fine	2, 3, 4	Smaller than 8 in.	90-100

TABLE 733-21A STONE FILLING GRADATION			
		Larger than 3 in.	50-100
		Smaller than No. 10 sieve	0-10
Light	2, 3, 4	Lighter than 100 lbs.	90-100
		Larger than 6 in.	50-100
Medium	2, 4	Smaller than ½ in.	0-10
		Heavier than 100 lbs.	50-100
Heavy	2, 4, 5	Smaller than 4 in.	0-10
		Heavier than 600 lbs.	50-100
		Smaller than 6 in.	0-10

TABLE 733-21B STONE FILLING APPROXIMATE SHAPE					
Specified Weights and Sizes					
600 lbs.	d=18 in.	d=23 in.	d=15 in.	d=23 in.	d=27 in.
300 lbs.	d=15 in.	d=18 in.	d=12 in.	d=18 in.	d=21 in.
150 lbs.	d=12 in.	d=15 in.	d=9 in.	d=15 in.	d=17 in.
100 lbs.	d=10 in.	d=13 in.	d=8 in.	d=13 in.	d=15 in.
d = 8 in.	50 lbs.	25 lbs.	100 lbs.	25 lbs.	16 lbs.
d = 6 in.	20 lbs.	10 lbs.	40 lbs.	10 lbs.	7 lbs.

**Notes:**

1. Stone sizes, other than weights, refer to the average of the maximum and minimum dimensions of a stone particle as estimated by the Engineer.
2. Materials shall contain less than 20% of stones with a ratio of maximum to minimum dimension greater than three.
3. Recycled material, cobbles or gravel having at least one fractured face per particle are acceptable substitutes for stone under these items, provided that the soundness and gradation requirements are met.
4. Materials shall contain a sufficient amount of stones smaller than the average stone size to fill in the spaces between the larger stones.
5. Heavier gradings of this item may be required on some projects, in which case the requirements will be stated in the contract documents.

**D. DURABILITY.** The soundness of all material used for stone filling shall be approved on the basis of a geologic evaluation in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

Where the State elects to conduct soundness tests, stone filling shall have a Magnesium Sulfate Soundness loss less than 10%, by weight, after 10 cycles.

For Stone Filling, Check Dam material, the soundness evaluation by a Departmental Engineering Geologist is waived.

**BASIS OF APPROVAL.** Stockpiles of stone filling will be evaluated in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

**BASIS OF ACCEPTANCE.** Stone filling from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Stone filling from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, stone filling will be accepted upon the basis of the stockpile approval.

**733-22 RIP-RAP**

**SCOPE.** This specification covers the material requirements and methods of testing rip-rap generally used in stream bank channel protection. The following rip-rap types are evaluated in this specification:

- 733-2201 – Dry Rip-Rap
- 733-2202 – Grouted Rip-Rap

**SAMPLING.** Perform material tests and assurance methods pertaining to rip-rap requirements in conformance with the procedures contained in the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

**MATERIAL REQUIREMENTS.**

**A. STOCKPILE.** Stockpile rip-rap in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*” except as noted herein.

**B. COMPOSITION.** Provide material consisting of blasted or broken unweathered rock.

**C. GRADATION.** Provide rip-rap material consisting of stones shaped as nearly as practicable in the form of right rectangular prisms having a gradation in accordance with TABLE 733-22A *Rip-Rap Gradation*. One dimension of each of the stones furnished shall be at least equal to the thickness of the rip-rap shown in the contract documents.

<b>TABLE 733-22A RIP-RAP GRADATION</b>	
<b>Stone Weight</b>	<b>Gradation Spread</b>
Heavier than 300 lbs.	50-100 percent of total by weight
$100 \text{ lbs.} \leq \gamma \leq 300 \text{ lbs.}$	Remainder of stones

**D. DURABILITY.** The soundness of all material used for rip-rap shall be approved on the basis of a geologic evaluation in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

Where the State elects to conduct soundness tests, rip-rap shall have a Magnesium Sulfate Soundness loss less than 10%, by weight, after 10 cycles.

**E. GROUT.** Provide grout manufacture materials conforming to Table 733-22B *Grouted Rip-Rap Grout Requirements*:

<b>TABLE 733-22B GROUTED RIP-RAP GROUT REQUIREMENTS</b>		
<b>Material</b>	<b>Subsection</b>	<b>Grout Mix</b>
Portland Cement Type 2	§701-01	1 part
Concrete Sand	§703-07	3 parts

**BASIS OF APPROVAL.** Stockpiles of rip-rap will be evaluated in accordance with the Geotechnical Control Procedure (GCP-14) “*Procedure for the Control of Stone Filling and Rip-Rap Items*”.

The material shall be subject to visual inspection by the Regional Geotechnical Engineer.

**BASIS OF ACCEPTANCE.** Rip-rap from approved off-site stockpiles will be accepted on the contract site by delivery ticket. Each delivery ticket shall identify the Suppliers name, Suppliers granular source number (GSN), date, NYSDOT contract number, stockpile number, and item number.

Rip-rap from approved stockpiles will be accepted upon successful completion of the Quality Assurance (QA) program indicating that the material conforms to the specification. If the QA program is not introduced, rip-rap will be accepted upon the basis of the stockpile approval

### **733-23 BEDDING MATERIAL**

(Last Revised May, 2022)

**SCOPE.** This specification covers the material requirements and methods of testing bedding material generally used as a foundation material prior to placing stone filling or rip-rap. The following bedding material types are evaluated in this specification:

733-2301 – Bedding Material, Type 1

733-2302 – Bedding Material, Type 2

**SAMPLING.** Sampling of coarse aggregates shall be in accordance with §703-02 *Coarse Aggregate*.

### **MATERIAL REQUIREMENTS.**

**A. SOURCE.** Provide bedding material from a source evaluated in accordance with the Materials Bureau procedure outlined in §703-02 *Coarse Aggregate* or from a source evaluated in accordance with the Geotechnical Control Procedure (GCP-17) *Procedure for the Control and Quality Assurance of Granular Materials*.

**B. COMPOSITION.** Provide material consisting of crushed stone or gravel (free of soft, non-durable particles, organic material, and thin or elongated particles) or recycled material approved for use in accordance with §733-19 *Recycled Materials Approved for Use as Earthwork Material* (and as identified in the Approved List).

**C. GRADATION.** Provide bedding material having a gradation of the appropriate Type in accordance with TABLE 733-23A *Bedding Material Type 1 Gradation* or TABLE 733-23B *Bedding Material Type 2 Gradation*.

TABLE 733-23A BEDDING MATERIAL TYPE 1 GRADATION	
Sieve Size Designation	Percentage Passing by Weight
4 in.	100
2 in.	40-60
½ in.	0-15
No. 200	0-2

TABLE 733-23B BEDDING MATERIAL TYPE 2 GRADATION	
Sieve Size Designation	Percentage Passing by Weight
1 ½ in.	100
1 in.	90-100
½ in.	25-60
¼ in.	0-10
No. 200	0-2

**D. DURABILITY.** Provide material meeting the soundness requirements of §703-02 *Coarse Aggregates* or §703-10 *Lightweight Aggregates*. When electing to use material from sources not approved under §703-02 or §703-10, provide material having a Magnesium Sulfate Soundness loss less than 20% in conformance with the procedures contained in the Geotechnical Test Method (GTM-21) *Test Method for Magnesium Sulfate Soundness of Granular Materials*.

**BASIS OF APPROVAL.** Sources will be approved in accordance with the Materials Bureau procedure outlined in §703-02 *Coarse Aggregate* or evaluated in accordance with the Geotechnical Control Procedure (GCP-17) “Procedure for the Control and Quality Assurance of Granular Materials”.

**BASIS OF ACCEPTANCE.** Approved bedding material from approved sources will be accepted upon successful completion of the Quality Assurance (QA) program introduced by the Regional Geotechnical Engineer indicating that the material conforms to the specification. If the QA program is not introduced, approved bedding material will be accepted upon Supplier Quality Control (QC) verification that the material conforms to the gradation requirements.

## SECTION 734 - CONCRETE SLAB OVERLAYS

### 734-01 THIN POLYMER (EPOXY) OVERLAY WEARING SURFACE FOR STRUCTURAL SLABS

**SCOPE.** This specification covers the Thin Polymer (Epoxy) Overlay System used as a wearing surface for Structural Slabs

**GENERAL.** The thin polymer (epoxy) overlay system will restore friction and protect the structural slab from further deterioration. The aggregate source(s) used with these systems will be evaluated by Main Office Geology for friction classification and approval.

**MATERIAL REQUIREMENTS.** The manufacturer will provide Materials Details Sheet for acceptance to the Department.

The details will provide the following:

**1. Product Information:**

- Identify Components
- Storage and handling requirements

**2. Surface Preparation:**

- Describe the method of cleaning
- Identify the required level of cleanliness
- Identify the bond strength
- Moisture and temperature requirements (Limitation)
- Address any structural repairs needed

**3. Application Procedures:**

- Describe all procedures in mixing, preparation and application

**4. Curing:**

- Describe curing procedure and anticipated cure times vs. temperature.

**PACKAGING.** All components shall be shipped in appropriate containers, bearing the manufacturer's label specifying date of manufacture, batch number, brand name, quantity, and date of expiration or shelf life.

**BASIS OF APPROVAL.** Each system supplier/manufacturer must undergo a two year field performance evaluation on two preapproved sites and provide Materials Details for approval.

**BASIS OF ACCEPTANCE.** Thin Polymer (Epoxy) Overlays systems will be accepted based on the product name appearing on the Departments Approved List for Thin Polymer (Epoxy) Overlays.

## **SECTION 735 - CONCRETE CYLINDER CURING BOX**

### **735-01 CONCRETE CYLINDER CURING BOX**

**SCOPE.** This specification covers the material requirements, tests and basis of acceptance for a Concrete Cylinder Curing Box.

**MATERIAL REQUIREMENTS.** The Concrete Cylinder Curing Box shall be constructed of noncorroding materials. A moisture proof seal shall be provided between the lid and body of the box. Provision for automatic control of water temperature to  $72^{\circ}\text{F} \pm 5^{\circ}\text{F}$  shall be made when the box is located in an uncontrolled environment. A bimetallic thermometer shall be installed with its sensing element in the storage water. The thermometer shall be capable of being read from the outside without opening the box. The thermometer shall have minimum gradations of  $2^{\circ}\text{F}$  and shall be protected from damage. Electric utility connections shall be made in a lockable switch box securely attached to the outside of the curing box.

A rustproof wire or metal rack shall be set above the bottom of the box to support cylinders in an upright position. This rack and all temperature control elements shall be positioned to allow free circulation of water around the cylinders. A combination hose connection and drain shall be provided at the lower front edge of the box so that it may be drained or water may be circulated. A drain shall also be provided on the box in such a position that when open will drain water to within 1 inch over the top of the cylinders. All areas of the box shall be easily drained and accessible for cleaning.

**Test.** The Concrete Cylinder Curing Box shall be capable of maintaining the required water temperature through an ambient air temperature range of -10°F to +100°F. The box shall be capable of holding a minimum of nineteen 6 x 12 inch cylinders. When filled with water, the box shall not leak.

**BASIS OF ACCEPTANCE.** The Concrete Cylinder Curing Box shall be accepted upon approval of the Engineer.

## **SECTION 736 - PERMANENT CORRUGATED METAL FORMS FOR BRIDGE SLABS**

### **736-01 PERMANENT CORRUGATED METAL FORMS FOR BRIDGE SLABS**

**SCOPE.** This specification covers the material requirements, method of manufacturer, tests and basis of acceptance for Permanent corrugated Metal Forms for Bridge Slabs for use as described under ' 557 Superstructure Slabs, Sidewalks on Bridges, and Structural Approach Slabs..

**MATERIALS.** Forms and form supports shall conform to the latest specification for ASTM A653/A653M, Grades A thru E, Coating Designation G165. Fabrication shall be in conformance with ASTM A924/A924M.

Prior to fabrication of forms the Contractors shall submit to the Engineer certification for conformity of steel and galvanizing to ASTM A653/A653M.

**DESIGN REQUIREMENTS.** The following shall govern the design of permanent corrugated metal stay-in place (S. I. P.) forms:

- Design Span shall be the clear span of form plus 2 inches measured parallel to the form flutes.
- Design Load shall be the sum of the weights of form, bar reinforcement, plastic concrete and 50 psf for construction loads.
- Unit Working Stress shall not exceed 0.725 of the specified minimum yield strength of the material. In no case shall the unit working stress exceed 36 ksi.
- Dead Load Deflection shall not exceed 1/180 of the form span or 1/2 inch, whichever is less.
- Physical Design Properties shall be computed with the requirements of the American Iron and Steel Institute Specifications for the Design of Cold Formed Steel Structural Members, latest published edition.

**Certification.** For acceptance, the Contractor shall submit Manufacturer certification to the Engineer that all forms meet all design requirements stated in this section and all detail requirements shown on the plans.

**Test.** No testing will be required.

**BASIS OF ACCEPTANCE.** All forms delivered to the job site must be accompanied by the manufacturer's certification that the materials used conform to ASTM A653/A653M as required by this section. Any forms delivered to the job site without such certification shall be rejected by the Engineer.

## **SECTION 737 - GEOSYNTHETICS**

(Last Revised September, 2016)

**QUALITY ASSURANCE PROGRAM.** The Department maintains a Quality Assurance (QA) program for geosynthetics appearing on the Approved List. For monitoring purposes, the Geotechnical



Engineering Bureau (GEB) will select and evaluate geosynthetic material delivered to project sites to compare its properties to those properties determined at the time of the product's initial approval, which may indicate a change has occurred in the manufacturing process or Quality Control (QC) process.

If selected, a QA sample of the following sizes of geosynthetic material will be obtained by a Departmental Geotechnical Engineer and will be submitted for testing:

§737-01 Geotextiles: 3 yd<sup>2</sup> QA sample.

§737-02 Geomembranes: 4 yd<sup>2</sup> QA sample.

§737-03 Prefabricated Vertical Drains: 10 ft. long QA sample.

§737-04 Prefabricated Composite Structural Drain: 3 yd<sup>2</sup> QA sample.

§737-05 Prefabricated Composite Integral Abutment Drain: 3 yd<sup>2</sup> QA sample.

§737-06 Prefabricated Composite Edge Drain: 6 ft. long QA sample.

The following scenarios may develop as a result of the QA testing.

1. The properties are shown to be comparable to those originally determined, within the statistical validity of the test. No action will be taken.
2. The properties are shown to be significantly different than originally determined.
  - a. If the results are within the acceptable minimum for approval, contact with the manufacturer will be made by the Geotechnical Engineering Bureau to determine what has changed.
  - b. If the results are below the minimum acceptable for approval, the product's status on the **NYSDOT TECHNICAL SERVICES APPROVED LIST OF GEOSYNTHETICS FOR HIGHWAY CONSTRUCTION - GEOTEXTILES (Approved List)** will be re-evaluated. The manufacturer will be notified of the review.

## **737-01 GEOTEXTILES**

**SCOPE.** This specification covers the material requirements and methods of testing geosynthetic materials used in highway construction. The following Geotextile Structure Types are evaluated in this specification:

737.0101 – Needle-Punched – Non-Woven	(NP – NW)
737.0102 – Heatbonded – Non-Woven	(HB – NW)
737.0103 – Monofilament – Woven	(MF – W)
737.0104 – Multifilament – Woven	(MuF – W)
737.0105 – Slit Film – Woven	(SF – W)
737.0106 – Combination Monofilament/Fibrillated Yarn – Woven	(C – W)
737.0107 – Recycled/ Reinforced Needle-Punched – Non-Woven	(R/R NP – NW)
737.0108 – Circular – Woven	(Cir – W)

**GENERAL.** The Department's evaluation of geotextiles submitted will be based on one or more of the following tests:

1. Soil Retention - The test to evaluate this characteristic will be performed in accordance with the Apparent Opening Size Test, ASTM D4751.
2. Mass per Unit Area - Test to evaluate this characteristic will be performed in accordance with ASTM D5261.
3. Flow Capacity - The test to evaluate this characteristic will be performed in accordance with the Permittivity Test, ASTM Method D4491.
4. Tensile Strength - The tests to evaluate this characteristic will be performed in accordance with the following:
  - a. Grab Test Method, ASTM D4632

- b. Trapezoid Tear Test Method, ASTM D4533
- c. Static Puncture Strength Using a 2 in. Probe, ASTM D6241

**Applications.** Based on the above tests and criteria that follow, the Geotextiles may be accepted for the following:

- Geotextile Bedding
- Geotextile Separation
- Geotextile Drainage
- Geotextile Slope Protection
- Geotextile Stabilization
- Turbidity Curtains
- Silt Fence

**MATERIAL REQUIREMENTS.** Following is a table of the requirements by applications:

**A. Geotextile Bedding.** Geotextile bedding shall meet the requirements of Table 737-01A.

TABLE 737-01A BEDDING GEOTEXTILE REQUIREMENTS										
Application	Geotextile Structure	Minimum Strength Class Requirements					Bedding Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
								Sieve Size (in.)	Sieve Designation	
Geotextile Bedding	C – W	1	< 50%	315	112	618	A	0.0165	No. 40	0.7
			≥ 50%	202	79	433	B	0.0098	No. 60	0.2
	MF - W	2	< 50%	247	56	495	C	0.0083	No. 70	0.1
			≥ 50%	157	56	309				

**B. Geotextile Separation.** Geotextile separation shall meet the requirements of Table 737-01B.

TABLE 737-01B SEPARATION GEOTEXTILE REQUIREMENTS							
Application		Minimum Strength Class Requirements				Separation Class Requirements	
		Class	Apparent Opening Size (maximum)	Minimum			

	Geotextile Structure	Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)		Sieve Size (in.)	Sieve Designation	Permittivity (sec <sup>-1</sup> )
Geotextile Separation	Any type listed in §737-01 Scope	2	< 50%	247	90 <sup>1</sup>	495	NA (X)	0.0234	No. 30	0.02
			≥ 50%	157	56	309				

Table 737-01B Notes:

<sup>1</sup> For woven monofilament geotextiles the minimum average value is 56 lbf.

**C. Geotextile Drainage.** Geotextile drainage shall meet the requirements of Table 737-01C.

TABLE 737-01C DRAINAGE GEOTEXTILE REQUIREMENTS										
Application	Geotextile Structure	Minimum Strength Class Requirements					Drainage Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
								Sieve Size (in.)	Sieve Designation	
Geotextile Drainage	Non-Woven	2	< 50%	247	90	495	A	0.0165	No. 40	0.5
			≥ 50%	157	56	309	B	0.0098	No. 60	0.2
		C	0.0083	No. 70	0.1					

**D. Geotextile Slope Protection.** Geotextile slope protection shall meet the requirements of Table 737-01D.

TABLE 737-01D SLOPE PROTECTION GEOTEXTILE REQUIREMENTS										
Application	Geotextile Structure	Minimum Strength Class Requirements					Slope Protection Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
								Sieve Size (in.)	Sieve Designation	
Geotextile Slope	NP - NW	1	< 50%	315	112	618	A	0.0165	No. 40	0.7
			≥ 50%	202	79	433	B	0.0098	No. 60	0.2

Protection							C	0.0083	No. 70	0.1
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**E. Geotextile Stabilization.** Geotextile stabilization shall meet the requirements of Table 737-01E.

TABLE 737-01E STABILIZATION GEOTEXTILE REQUIREMENTS										
Application	Geotextile Structure	Minimum Strength Class Requirements					Stabilization Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
								Sieve Size (in.)	Sieve Designation	
Geotextile Stabilization	Any type listed in §737-01 Scope	1	< 50%	315	112	618	NA (X)	0.0165	No. 40	0.05
			≥ 50%	202	79	433				

**F. Turbidity Curtain.** Turbidity curtains shall meet the requirements of Table 737-01F.

TABLE 737-01F TURBIDITY CURTAIN REQUIREMENTS										
Application	Geotextile Structure	Minimum Strength Class Requirements					Turbidity Curtain Class Requirements			
		Class	Percent Elongation (%)	Grab Strength (lbf)	Tear Strength (lbf)	Puncture Strength (lbf)	Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
								Sieve Size (in.)	Sieve Designation	
Turbidity Curtain	Any type listed in §737-01 Scope	2	< 50%	247	90 <sup>1</sup>	495	NA (X)	0.0117	No. 50	0.4
			≥ 50%	157	56	309				

Table 737-01F Notes:

<sup>1</sup> For woven monofilament geotextiles the minimum average value is 56 lbf.

**G. Silt Fence.** Silt fences shall meet the requirements of Table 737-01G.

TABLE 737-01G SILT FENCE REQUIREMENTS										
										Silt Fence Class Requirements

Application	Geotextile Structure	Minimum Strength Class Requirements						Class	Apparent Opening Size (maximum)		Minimum Permittivity (sec <sup>-1</sup> )
		Max. Post Spacing (ft.)	Percent Elongation (%)	Grab Strength (lbf)	Orientation <sup>3</sup>	Fence Between Posts	Designation		Sieve Size (in.)	Sieve Desig.	
Silt Fence	Any type listed in §737-01 Scope	4.0	NA	90	MD	Supported <sup>1</sup>	s	NA (X)	0.0234	No. 30	0.05
					XD						
		4.0	≥ 50% <sup>2</sup>	123	MD	Unsupported	us 4.0				
				101	XD						
		6.5	< 50% <sup>2</sup>	123	MD	Unsupported	us 6.5				
				101	XD						

Table 737-01G Notes:

- <sup>1</sup> Silt fence support shall consist of 14 gage steel wire with a mesh spacing of 6 in. x 6 in. or prefabricated polymeric mesh with a minimum ultimate tensile strength of 200 lb/ft in both machine and cross machine directions measured in accordance with ASTM D6637.
- <sup>2</sup> As measured in accordance with ASTM D4632.
- <sup>3</sup> MD = Machine Direction, XD = Cross-Machine Direction.

**BASIS OF APPROVAL.** All geotextiles, including those sold under a private label agreement, being submitted for testing and approval must be submitted through the American Association of State Highway and Transportation Officials (AASHTO) National Transportation Product Evaluation Program (NTPEP). The program has a rolling submission cycle. Information regarding submittal is available at the address shown below:

AASHTO-NTPEP Coordinator  
444 N. Capitol St., NW, Suite 249  
Washington, DC 20001  
[www.ntpep.org](http://www.ntpep.org)

The approval criterion for geotextiles is based on AASHTO M-288 *Specification for Geotextiles* and material properties listed in NTPEP's DataMine.

Approved geotextiles will be added to the Approved List.

**BASIS OF ACCEPTANCE.** Geotextiles will be accepted based on the following:

- A. For full width rolls:
  1. At the time of placement, the material brand name and style shall be listed, for the intended application, on NYSDOT's Approved List for Geotextiles.
  2. The roll of material shall be properly identified by having NTPEP-compliant labels affixed by the product manufacturer to:

- a. both ends of the outside of the geotextile roll outer wrapping, and
  - b. both ends of the inside of the geotextile roll core where they are easily visible for inspection. The labels shall be attached in a manner that would make them difficult to remove or replace.
- Note:** As a minimum, the label shall contain the following information:
- i. the product name (if the manufacturer is supplying the product to a private label company, the product name is the one that will be used by the private label company),
  - ii. The roll number,
  - iii. The production date,
  - iv. AASHTO M288 class(es) the product meets (or “NTPEP listed” if no class applies).

If the permanent marking described in Section 3 below contains all the information required for the labels, the labels on one end of the roll may be eliminated.

- 3. Permanent Marking: The roll of material shall be marked with a clearly legible print located on the roll selvages at a frequency of once per 16.4 ft. and showing, as a minimum, the manufacturing plant (or manufacturing plant ID code numbers).
- 4. A material certification submitted with the geotextile stating that the material conforms to the specification and that it is the same one appearing on the Approved List.

**B.** For modified products (those that have been fabricated by a Converter by modifying full-width rolls by cutting, re-rolling, etc. (i.e. silt fence, turbidity curtains)):

- 1. After re-wrapping, the Converter must attach new NTPEP-compliant labels, as described in Section 3 above, on each roll/package of converted product. Compliant labels include:
  - a. The original (prime) manufacturer’s manufacturing code and date of production.
  - b. The converter’s manufacturing code, style number, roll number\* and date of conversion. (\* Converter roll number will be the manufacturer’s assigned roll number with a suffix designating the sequentially derived roll/package from the original roll, a.k.a. parent-child identification.)
  - c. Four labels are required on each converted roll/package – one inside the core and one on the outside wrapping at each end.

## 737-02 GEOMEMBRANES

**SCOPE.** This specification covers the material requirements and methods of testing unreinforced geomembranes used in highway construction. The following geomembrane types are evaluated in this specification:

737.0201 – Geomembrane, Unreinforced

**GENERAL.** The Department's evaluation of unreinforced geomembranes submitted will be based on the following tests:

- 1. Tensile Strength - Test in accordance with ASTM D4632, Grab Test Method.
- 2. Elongation - Test in accordance with ASTM D4632.
- 3. Trapezoidal Tear Resistance - Test in accordance with ASTM D4533, Trapezoid Tear Test Method.
- 4. Puncture - Test in accordance with ASTM D4833, Index Puncture Resistance.

**MATERIAL REQUIREMENTS.** Unreinforced geomembranes shall meet the following requirements:

- 1. Ultimate Tensile Strength – 180 lbf<sup>(1)</sup>
- 2. Ultimate Elongation - 65%<sup>(1)</sup>
- 3. Trapezoid Tear Resistance - 60 lbf<sup>(1)</sup>

4. Puncture - 90 lbf<sup>(2)</sup>
- (1) Minimum value in weaker principal direction. The average of the test results in the weaker principal direction shall be equal to or greater than the stated values.
  - (2) The average of the test results for puncture shall meet or exceed the stated value.

**BASIS OF APPROVAL.** Producers of geomembranes shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number GE-335 *Product Evaluation Form (PEF) for Geosynthetics*.
2. A test data sheet identifying the geomembrane properties.
3. A 10 sq yd sample of geomembrane to allow for testing by the Department.

Approved geomembranes will be added to the Approved List.

**BASIS OF ACCEPTANCE.** Unreinforced geomembranes will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the geomembrane or the container. The container may be either the cover wrapping or the core around which the geomembrane is rolled,
2. The material brand name and style appearing on the Approved List for the intended application, and
3. The material certification submitted with the geomembrane stating that the material conforms to the specification and that it is the same one appearing on the Approved List.

### **737-03 PREFABRICATED VERTICAL DRAINS**

**SCOPE.** This specification covers the material requirements and methods of testing prefabricated vertical drains used in highway construction.

**GENERAL.** The Department's evaluation of prefabricated vertical drains submitted will be based on the following tests:

1. Prefabricated Vertical Drain:
  - a. Equivalent Sand Drain Diameter - Test in accordance with NYSDOT - GEB Large Diameter Consolidation Test.
2. Cover Geotextile Wrapping:
  - a. The requirements listed in Geotextile Drainage (Table 737-01C).

**MATERIAL REQUIREMENTS.** Prefabricated Vertical Drains shall meet the following requirements:

1. Prefabricated Vertical Drain:
    - a. Equivalent Sand Drain Diameters – 1 ½ in. minimum.<sup>(1)</sup>
  2. Cover Geotextile Wrapping:
    - a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be tightly wrapped around the core.
- (1) The average of the test results shall meet or exceed the stated values.

**BASIS OF APPROVAL.** Producers of prefabricated vertical drains shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number GE-335 *Product Evaluation Form (PEF) for Geosynthetics*.
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 30 ft. long sample of the prefabricated vertical drain to allow for testing by the Department.

Approved prefabricated vertical drains will be added to the Approved List.

**BASIS OF ACCEPTANCE.** Prefabricated vertical drains will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the prefabricated vertical drain or the container. The container may be either the cover wrapping or the core around which the prefabricated vertical drain is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the prefabricated vertical drain stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. A letter identifying the Manufacturer and product name of the geotextile cover wrapping that states that the geotextile appears on the Approved List for Geotextile Drainage, and states that it is the same geotextile identified in the material certification for the prefabricated vertical drain.

### **737-04 PREFABRICATED COMPOSITE STRUCTURAL DRAINS**

**SCOPE.** This specification covers the material requirements and methods of testing prefabricated composite structural drains (PCSD's)<sup>(1)</sup> used in highway construction.

**GENERAL.** The Department's evaluation of PCSD's submitted will be based on the following tests:

1. PCSD: Flow Capacity Under Load - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
2. Cover Geotextile Wrapping: The requirements listed in Geotextile Drainage (Table 737-01C).

**MATERIAL REQUIREMENTS.** The PCSD shall meet the following requirements:

1. PCSD:
  - a. Hydraulic Transmissivity
    - i. For impermeable cores, where flow is allowed on both sides, the hydraulic transmissivity shall be 4.0 gal./min./ft. of width under 1500 psf and a hydraulic gradient of 0.1<sup>(2)</sup>.
    - ii. For permeable cores, or one sided flow impermeable cores, the hydraulic transmissivity shall be 2.0 gal./min./ft. of width under 1500 psf and a hydraulic gradient of 0.1<sup>(2)</sup>.
2. Cover Geotextile Wrapping:
  - a. The requirements listed in Geotextile Drainage (Table 737-01C) Class A. The geotextile shall be bonded to the core.

<sup>(1)</sup> This includes prefabricated composite structural drains used as integral abutment drains.

<sup>(2)</sup> The average of the test results shall meet or exceed the stated values.

**BASIS OF APPROVAL.** Producers of PCSD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number GE-335 *Product Evaluation Form (PEF) for Geosynthetics*.
2. A test data sheet identifying the properties of the protective geotextile and the core.
3. A 4 sq. yd. sample of the PCSD drain to allow for testing by the Department.

Approved PCSD's will be added to the Approved List.

**BASIS OF ACCEPTANCE.** PCSD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCSD or the container. The container may be either the cover wrapping or the core around which the PCSD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,



3. The material certification submitted with the PCSD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. A letter identifying the Manufacturer and product name of the geotextile cover wrapping that states that the geotextile appears on the Approved List for Geotextile Drainage, and states that it is the same geotextile identified in the material certification for the PCSD.

### **737-05 PREFABRICATED COMPOSITE INTEGRAL ABUTMENT DRAINS**

**SCOPE.** This specification covers the material requirements and methods of testing prefabricated composite integral abutment drains (PCIAD's) used in highway construction.

**GENERAL.** PCIAD's shall meet the requirements of PCSD except that the minimum thickness of the PCIAD shall be 0.4 in. as measured by ASTM D5199.

**BASIS OF APPROVAL.** Producers of PCIAD's shall demonstrate the quality of their products before being placed on the Department's Approved List. The approval procedure for PCIAD's follows the approval procedure for PCSD's.

Approved PCIAD's will be added to the Approved List.

**BASIS OF ACCEPTANCE.** PCIAD's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCIAD or the container. The container may be either the cover wrapping or the core around which the PCIAD is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCIAD stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. A letter identifying the Manufacturer and product name of the geotextile cover wrapping that states that the geotextile appears on the Approved List for Geotextile Drainage, and states that it is the same geotextile identified in the material certification for the PCIAD.

### **737-06 PREFABRICATED COMPOSITE EDGE DRAINS**

**SCOPE.** This specification covers the material requirements and methods of testing prefabricated composite edge drains (PCED's) used in highway construction.

**GENERAL.** The Department's evaluation of PCED's submitted will be based on the following tests:

1. PCED:
  - a. Flow Capacity - Test in accordance with ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
2. Cover Geotextile Wrapping:
  - a. The requirements listed in Geotextile Drainage (Table 737-01C).

**MATERIAL REQUIREMENTS.** PCED's shall meet the following requirements:

1. PCED:
  - a. Flow Capacity – 15 gal./min./ft. of width when tested at a 10 psi load after 100 hours, at a hydraulic gradient of 0.1. If the flow channel is separated into two or more parts, only the flow rate of the section facing the pavement will be considered.
2. Cover Geotextile Wrapping:

- a. The requirements listed in Geotextile Drainage (Table 737-01C). The geotextile shall be bonded to the core or tightly wrapped around the core.

**BASIS OF APPROVAL.** Producers of PCED's shall demonstrate the quality of their products before being placed on the Department's Approved List. The producer shall provide:

1. A completed Form Number GE-335 *Product Evaluation Form (PEF) for Geosynthetics*.
2. A test data sheet identifying the cover geotextile and core and their properties.
3. A 10 ft. long sample of the PCED to allow for testing by the Department.

Approved PCED's will be added to the Approved List.

**BASIS OF ACCEPTANCE.** PCED's will be accepted on the basis of:

1. The roll of material being properly identified either by a label on the PCED or the container. The container may be either the cover wrapping or the core around which the PCED is rolled,
2. The material brand name and style appearing on the Approved List for the intended application,
3. The material certification submitted with the PCED stating that the material conforms to the specification and that it is the same one appearing on the Approved List, and
4. A letter identifying the Manufacturer and product name of the geotextile cover wrapping that states that the geotextile appears on the Approved List for Geotextile Drainage, and states that it is the same geotextile identified in the material certification for the PCED.

## 737-07 GEOGRIDS

**SCOPE.** This specification covers the material requirements and methods of testing geogrids used in highway construction.

**GENERAL.** Submit the geogrid material certification with the material. Include in the certification the geogrid manufacturer's name, the geogrid name, the test lot number, the minimum average roll value for Ultimate Tensile Strength, the long-term design tensile strength, and the reduction factors used to calculate the long-term design tensile strength. The following definitions apply:

- A.  $T_D$ .** Long Term Design Tensile Strength =  $T_{ULT}/RF$ .
- B.  $T_{ULT}$ .** Ultimate Tensile Strength. Determined in the primary strength direction in accordance with ASTM D4595 or D6637, based on the Minimum Average Roll Value (MARV), per ASTM D4759, for the product.
- C.  $RF$ .** Total Reduction Factor =  $RF_{CR} \times RF_{ID} \times RF_{DU}$ .
- D.  $RF_{CR}$ .** Reduction Factor for Creep Deformation for 100 Year Design Life. Calculated in accordance with Geosynthetic Research Institute Standard Practice GRI-GG4 using ASTM D5262 to determine long term strength,  $T_{LT}$ , and ASTM D4595 to determine short term strength,  $T_{ST}$ .
- E.  $RF_{ID}$ .** Reduction Factor For Installation Damage Calculated in Accordance with Geosynthetic Research Institute Standard Practice GRI-GG4. The minimum tested  $RF_{ID}$  value permitted is 1.1.
- F.  $RF_{DU}$ .** Reduction Factor for Durability. Determined in Accordance with EPA9090 and ASTM D4595. The minimum tested  $RF_{DU}$  value permitted is 1.1.

**MATERIAL REQUIREMENTS.** Geogrid reinforcing shall be tested and certified to meet the minimum requirements for geosynthetic products in accordance with AASHTO Specifications for Highway Bridges, *Geosynthetic Reinforcement*.

**BASIS OF ACCEPTANCE.** Geogrids will be accepted on the basis of:

1. A material certification identifying:
  - a. The geogrid manufacturer's name,

- b. The geogrid name,
  - c. The test lot number,
  - d. The minimum average roll value for Ultimate Tensile Strength,
  - e. The long-term design tensile strength, and
  - f. The reduction factors used to calculate the long-term design tensile strength.
2. An evaluation to verify that the long-term tensile design strength of the geogrid meets or exceeds the required design value stated in the contract documents, based on appropriate reduction factors.

**737-08 GEOCELLS**

**SCOPE.** This specification covers the material requirements and methods of testing geocells used in highway construction.

**GENERAL.** Submit the geocell material certification with the material. Include in the certification the geocell manufacturer’s name, the geocell name, the test lot number, the minimum thickness, the cell seam peel strength, the ultraviolet stability, and the environmental stress crack resistance.

**MATERIAL REQUIREMENTS.** Geocells shall be made of High Density Polyethylene (HDPE) of the size(s) and dimensions shown in the contract documents. Geocells shall be tested and certified to meet the minimum requirements listed in Table 737-08 *Geocell Requirements*.

<b>TABLE 737-08 GEOCELL REQUIREMENTS</b>		
<b>Property</b>	<b>Test Method</b>	<b>Requirement</b>
Thickness	ASTM D 5199	0.04 in. minimum
Cell Seam Peel Strength	Per U.S. Army Corps of Engineers Technical Report GL-86-19 Appendix A	56 lbf per inch of cell depth, minimum
Ultraviolet Stability	ASTM D 1603 or ASTM D 4218	1.5 % by weight carbon black minimum
Environmental Stress Crack Resistance	ASTM D 1693	2000 hrs minimum

Geocells will be perforated with the exception of the fascia, which will be solid and green in color.

**BASIS OF ACCEPTANCE.** Geocells will be accepted on the basis of

- 1. A material certification identifying:
  - a. The geocell manufacturer’s name,
  - b. The geocell name,
  - c. The test lot number,
  - d. The minimum thickness,
  - e. The cell seam peel strength,
  - f. The ultraviolet stability, and
  - g. The environmental stress crack resistance.
- 2. An evaluation that the information on the material certification meets the minimum requirements for the geogrids stated in Table 737-08 and the contract documents.

## 737-09 GEOSYNTHETIC FIBERS

**SCOPE.** This specification covers the material requirements and methods of testing geosynthetic fibers used in highway construction.

**GENERAL.** Submit the geosynthetic fiber material certification with the material. Include in the certification the geosynthetic fiber manufacturer's name, the geosynthetic fiber name, the test lot number, the polypropylene percentage, fiber length, specific gravity, carbon black content, tensile strength, tensile elongation and Young's modulus.

**MATERIAL REQUIREMENTS.** Geosynthetic fibers shall consist of fibrillated polypropylene strands and shall be tested and certified to meet the minimum requirements listed in Table 737-09 *Geosynthetic Fiber Requirements*.

TABLE 737-09 GEOSYNTHETIC FIBER REQUIREMENTS		
Property	Test Method	Requirement
Polypropylene	ASTM D4101 Group 1/ Class 1/ Grade 2	99.4 % minimum
Fiber Length	Measured	1 inch
Specific Gravity	ASTM D792	0.033 lb/in <sup>3</sup>
Carbon black Content	ASTM D1603	0.6 % minimum
Tensile Strength	ASTM D2256	45 ksi minimum
Tensile Elongation	ASTM D2256	15 % maximum
Young's Modulus	ASTM D2101	700 ksi minimum

**BASIS OF ACCEPTANCE.** Geosynthetic fibers will be accepted on the basis of

1. A material certification identifying:
  - a. The geosynthetic fiber manufacturer's name,
  - b. The geosynthetic fiber name,
  - c. The test lot number,
  - d. The polypropylene percentage,
  - e. The fiber length,
  - f. The specific gravity,
  - g. The carbon black content,
  - h. The tensile strength,
  - i. The tensile elongation, and
  - j. Young's modulus.
2. An evaluation that the information on the material certification meets the minimum requirements for the geosynthetic fiber stated in Table 737-09 *Geosynthetic Fiber Requirements* and the contract documents.

## SECTION 738 STORMWATER MANAGEMENT AND TREATMENT

(New Section May, 2022)

### 738-01 STORMWATER TREATMENT DEVICE (SWTD)

**SCOPE.** This specification covers the material requirements and testing methods for Stormwater Treatment Devices (SWTDs).

**MATERIAL REQUIREMENTS.** SWTDs are categorized by maximum flow capacity. Flow capacity is the maximum flow that the device can accommodate while maintaining the minimum specified total suspended solids (TSS) removal efficiency. SWTDs are further specified by their use in either redevelopment or new construction. Redevelopment is the reconstruction of existing impervious surfaces. New construction is the construction of new impervious surfaces.

SWTDs shall meet the following requirements:

1. All precast concrete elements shall meet the requirements of §704-03 *Precast Concrete – General*.
2. Manhole frames and covers shall meet the requirements of §655 *Frames, Grates and Covers*.

**A. Hydrodynamic Separator** SWTDs treat runoff from redevelopment activity and shall have a minimum 50% TSS removal efficiency.

<b>TABLE 738-1 HYDRODYNAMIC SEPARATORS TREATMENT FLOW RATE</b>	
	Treatment flow rate
738-0101	Up to 1.0 cfs
738-0102	Over 1.0 cfs up to 2.0 cfs
738-0103	Over 2.0 cfs up to 2.8 cfs
738-0104	Over 2.8 cfs up to 3.8 cfs
738-0105	Over 3.8 cfs up to 5.0 cfs
738-0106	Over 5.0 cfs up to 7.0 cfs
738-0107	Over 7.0 cfs up to 10.0 cfs
738-0108	Over 10.0 cfs up to 15.0 cfs
738-0109	Over 15.0 cfs up to 25.0 cfs

**BASIS OF APPROVAL.** For consideration of placement on the Approved List, the manufacturer shall submit the following information for each SWTD type:

1. **Total Suspended Solids (TSS) Removal.** The manufacturer must submit laboratory test documentation verifying that the SWTD meets the TSS removal goal (50% removal efficiency). Laboratory testing procedures used to determine a SWTD’s ability to remove TSS shall be as described in either the:
  - *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydraulic Sedimentation Manufactured Treatment Device* (the New Jersey Protocol). The submitted tests must be conducted by a laboratory;
    - certified by a National Environmental Laboratory Accreditation Program (NELAP),
    - ISO recognized accreditation body, or
    - an independent or in-house New Jersey Corporation for Advanced Technology (NJCAT) approved laboratory
 to conduct the specific test methods described in the protocol. Refer to the New Jersey Protocol for addition information on laboratory and test requirements.
  - Washington State Department of Ecology’s *Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies – Technology Assessment Protocol – Ecology (TAPE)* (WA State Manual). The submitted tests must be conducted at a Washington State Department of Ecology (Ecology) approved Stormwater Technology Evaluation Facility using the protocol described in the WA State Manual. Refer to the WA State Manual for additional information on evaluation facility and test requirements.

2. **Flow Capacity** - The flow capacity shall be the Maximum Treatment Flow Rate the system can pass while removing at least 50% TSS.

The manufacturer must submit laboratory test results verifying that the SWTD meets the TSS removal goal (at least 50% TSS removal efficiency) at the specified flow rate. Further, the manufacturer must submit evidence that the SWTD has been certified to remove at least 50% TSS at the specified flow rate.

3. **Manufacturer's Information** - The manufacturer's cut sheets, installation details, and operations and maintenance manuals for each SWTD type.
4. **Fabricator Standard Drawings** - Fabricator standard drawings, prepared in accordance with the requirements of §704-03 *Precast Concrete*.
5. **Third Party Verification** - The manufacturer shall also submit:
  - A verification report from the NJCAT and certification from the New Jersey Department of Environmental Protection (NJDEP), based on laboratory testing, documenting that the SWTD meets the technology performance criteria. The verification report must include the NJCAT verification seal and/or letter of acceptance, or
  - An approved Technical Evaluation Report (TER) that verifies the product has been certified by the State of Washington Technology Assessment Protocol – Ecology (TAPE) program with a General Use Level Designation (GULD).

Approved SWTDs will be added to the Approved List.

Five Year Approved List Renewal: Every five (5) years, the Department must receive:

- a letter from the manufacturer certifying that no changes have been made to the stormwater treatment device, manufacturer, or manufacturing location, and
- updated Approved List package (see items 1-5 under Basis of Approval),
- any changes to the device,
- renewal to NJCAT and or TAPE list.

If the approved list application package and letter are not received, the product may be removed from the Approved List. Further, an approved stormwater treatment device may be removed from the Approved List at any time if the Department is not notified in writing of any manufacturing or material changes as stated above.

**BASIS OF ACCEPTANCE.** SWTD products will be accepted based on the SWTD brand name and model appearing on the Approved List for the intended flow rate and pollutant removal efficiency, and the submission of a material certification for the SWTD stating that the product conforms to the specification and is the same model that appears on the Approved List.

## **SECTION 739 (VACANT)**

## **SECTION 740 – FOR SITE MANAGER USE**

(New Section May, 2018)

**740-01 THRU 740-04 FOR SITE MANAGER USE**

**SECTION 741 – FOR SITE MANAGER USE**  
(New Section May, 2018)

**741-01 THRU 740-04 FOR SITE MANAGER USE**

**SECTIONS 742 THRU 794 (VACANT)**

**SECTION 795 – FOR SITE MANAGER USE**  
(New Section May, 2018)

**SECTIONS 796 THRU 799 (VACANT)**